Benthic TMDL Development

Stressor Analysis Report

North Fork and South Fork Pound River

Wise County, Virginia

Submitted by:

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1.0 Introduction

The South Fork Pound River was originally listed as impaired on Virginia's 1994 Section 303(d) Total Maximum Daily Load Priority List and Report due to water quality violations of the general aquatic life (benthic) standard. In 1996, a segment of the North Fork Pound River below North Fork Pound Lake was also added. As a result, the Environmental Protection Agency (EPA) added these segments to a 1998 consent order requiring TMDLs by 2008. Since then, two headwater tributaries to the South Fork Pound River – Donald Branch and Phillips Creek – were separately added to the 305(b) list in 2002.

The Virginia Department of Environmental Quality (DEQ) has delineated the benthic impairment on the South Fork Pound River (segment VAS-Q13R-01) as a stream length of 6.53 miles. The watershed draining to stream segment VAS-Q13R-01 also includes 2 other impaired headwater segments: 1.87 miles of Donald Branch; and 2.14 miles of Phillips Creek (collectively known as segment VAS-Q13R-04). The impaired stream segment on the South Fork Pound River begins at the downstream confluence with the North Fork Pound River and extends upstream to the confluence of its Donald Branch and Phillips Creek. The delineated impaired segment on the North Fork Pound River (segment VAS-Q13R-02) is 1.11 miles long and extends from its downstream confluence with the South Fork, upstream to the North Fork Pound Lake dam.

A part of the Tennessee-Big Sandy River basin, the North Fork and South Fork Pound River watersheds comprise the upstream portion of state hydrologic unit Q13 (the complete National Watershed Boundary Dataset watershed BS28), and are located south and west of Pound in Wise County, Virginia. The combined watersheds are 23,364 acres in size. The main land use category in the combined watersheds is forest, which comprises approximately 68% of the total watershed area. The remainder includes 23% in mining-related land uses, 5% in agriculture, and 4% in urban/residential land uses. Donald Branch and Phillips Creek flow into the South Fork Pound River. The North and South Forks of Pound River flow into the Pound River which flows northeasterly into Russell Fork, which flows northwesterly into Kentucky, where it enters the Levisa Fork. Levisa Fork flows into the Big Sandy River, which then flows into the Ohio River, then into the Mississippi River and on to the Gulf of Mexico.

The North Fork and South Fork Pound watersheds are located entirely within the Cumberland Mountains sub-division of the Central Appalachians ecoregion. The Central Appalachians is primarily a high, dissected, rugged plateau which is composed of sandstone, shale, conglomerate and coal. The land cover is mostly forested due to rugged terrain, cool climate and infertile soils limiting agriculture. Bituminous coal mines are common in this region that may cause siltation and acidification of streams (USEPA, 2002).

The soils found in the North Fork and South Fork Pound River watersheds are primarily in the Berks-Pineville-Rock Outcrop soil association (85.4%). The Berks series (loamy-skeletal, mixed, active, mesic Typic Dystrudepts) consists of moderately deep, well drained soils formed in residuum weathered from shale, siltstone and fine grained sandstone on rounded and dissected uplands. Slope ranges from 0 to 80 percent. Permeability is moderate or moderately rapid. The Pineville series (fine-loamy, mixed, active, mesic Typic Hapludults) consists of very deep, well drained soils with moderately rapid permeability. These soils formed in colluvium derived from sandstone, shale, and siltstone. Pineville soils are on mountain coves, lower sideslopes, and footslopes. Slope ranges from 8 to 80 percent but is dominately 25 to 60 percent (USDA-NRCS, 2007).

Climate data for the North Fork and South Fork Pound River watersheds were based on meteorological observations made by National Climatic Data Center stations located within Wise County, Virginia. Daily precipitation was obtained from the North Fork Pound Lake weather station (446173), which has an average annual precipitation of 47.13 inches. Since temperature data was not recorded at this station, temperature data were obtained from a nearby station. The next closest station to the North Fork and South Fork Pound River watersheds is the Wise 3 E station (449215) which lies 6.0 miles (9.6 km) southeast of the watershed. Average annual daily temperature at the Wise station is 53.2°F. The highest average daily temperature of 82.1°F occurs in July while the lowest average daily temperature of 23.2°F occurs in January, as obtained from the 1971-2000 climate normals (NCDC-NOAA, 2007).

Land uses for the North Fork and South Fork Pound River watersheds were derived from the Mid-Atlantic Regional Earth Science Application Center (RESAC) and modified with abandoned mine land (AML) features digitized from USGS 7½-minute topographic maps and a shapefile of current mining permit boundaries from the Virginia Department of Mines, Minerals, and Energy's Division of Mine Land Reclamation (DMLR). The RESAC data is available from DCR upon request and was derived from digital remote sensing and spatial information technologies. Some additional editing was done to reclassify portions of the "barren" and "extractive" classifications which were inconsistent with residential features observed in Virginia Base Mapping Program (VBMP) aerial imagery. The 38 land uses in the RESAC data were categorized and three mined land use categories added for spatial analysis: AML, AML within a permit (to be reclaimed), and other permit areas (new mining). Land uses in the watersheds corresponding to the watersheds corresponding to each of the 4 impaired segments in the North Fork and South Fork Pound River watersheds are shown in Figure 1.1 and tabulated in Table 1.1.

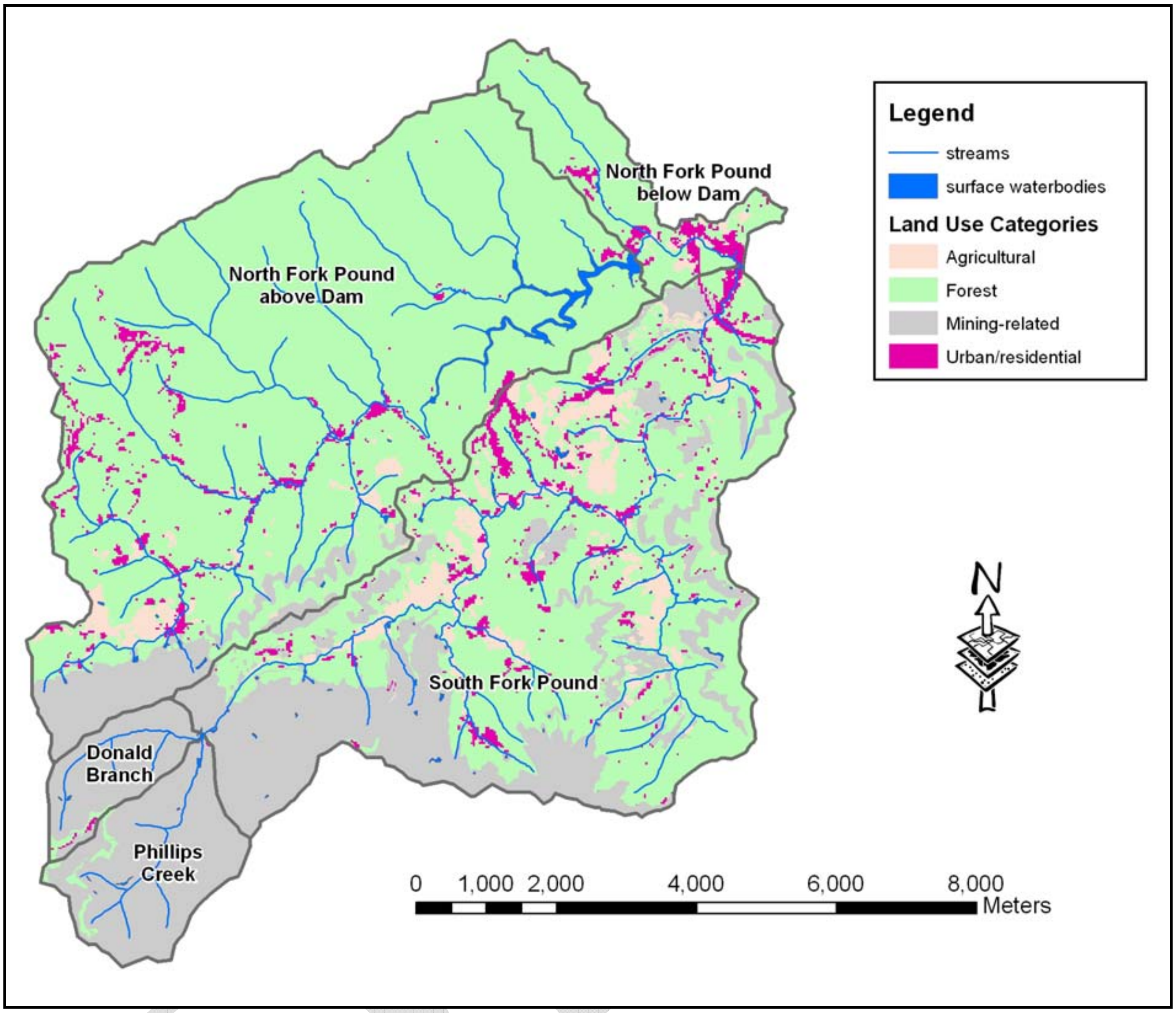

Figure 1.1. Land Use in North Fork and South Fork Pound River Watersheds

Table 1.1. North Fork and South Fork Pound River Land Use Category Distribution

Land Use Description	Land Use Category	North Fork above Reservoir (ha)	North Fork below Reservoir (ha)	South Fork (ha)	Donald Branch (ha)	Phillips Creek (ha)
Low Intensity Developed	Residential/Urban	11.2	6.4	15.2	0.0	0.0
Medium Intensity Developed	Residential/Urban	0.3	2.2	0.4	0.0	0.0
High Intensity Developed	Residential/Urban	6.0	9.6	12.6	0.0	0.0
Transportation	Residential/Urban	0.0	6.1	6.1	0.0	0.0
Urban / Residential / Recreational Grass	Residential/Urban	6.1	0.4	0.0	0.0	0.0
Extractive	Mining	5.8	0.3	83.6	1.6	3.8
Barren	Residential/Urban	113.3	21.1	161.4	2.3	0.2
Pasture / Hay	Agriculture	94.7	19.4	325.1	0.0	0.0
Croplands	Agriculture	11.9	0.0	18.3	0.0	0.0
Forest	Forest	3,915.7	404.9	2,124.8	11.5	19.2
AML	Mining	74.4	0.0	268.9	0.0	0.0
AML Within a Permit	Mining	100.3	0.0	204.2	91.4	36.4
DMLR Permit Area	Mining	99.6	0.0	569.2	144.8	444.2
Total Area		**4,439.2**	**470.6**	**3,789.8**	**251.7**	**503.8**

2.0 Data Sources Used in Stressor Identification

The DEQ 2004 Fact Sheets for Category 5 Waters (VADEQ, 2004a) state the following stream segment impairments based on assessments at the biological stations in parentheses: North Fork Pound River (6APNK000.08) is moderately impaired, South Fork Pound River (6APNS000.40, 6APNS003.94, 6APNS004.98) is severely impaired, Phillips Creek upstream from the North Fork Pound Lake (6APLL000.17) is not impaired; while a second Phillips Creek and Donald Branch, upstream from station 6APNS008.73 were also listed as severely impaired. The initial listing for South Fork Pound River was in 1994, North Fork Pound River in 1996, and Phillips Creek and Donald Branch within the South Fork Drainage in 2002. The source of impairment in North Fork Pound River was considered to be "Urban NPS," and the source of impairment in all South Fork Pound River segments was considered to be "Resource Extraction." In order to investigate and verify the stressor(s) causing the benthic impairment, available bioassessment data, water quality data, special study data, permitted point source permitted data, and ancillary data were examined together with field observations. The extent and content of these data sources are summarized in Table 2.1.

Table 2.1. Inventory of Data Used in North Fork and South Fork Pound River Stressor Analysis

Data Type/Location	Stream	Collection Period	No. Samples	Description
VADEQ Biological (Benthic) Samples				
PLL000.17	Phillips Creek	2001	1	Species counts Rapid Bioassessment Protocol (RBP II) metrics, scores, and ratings (Barbour et al., 1999) Stream Condition Index (SCI) scores and ratings (Tetra Tech, 2002) Habitat assessment scores
PNK000.08	N.F. Pound R.	1990-2000, 2006	16	
PNK008.28		2004	1	
PNS000.40	South Fork Pound River	1990-2000	14	
		2006	2	
PNS003.94		2001	2	
PNS004.98		1999, 2006	1, 2	
PNS008.73		1999, 2006	1, 2	
VADEQ Ambient Water Quality Samples				
PLL000.09	Phillips Creek	1972-1976	35	Monthly ambient physical and chemical water quality data.
PNK000.08	N.F. Pound R.	2006-2007	11	
PNK001.10	N.F. Pound R.	2007	3	
PNS003.38	South Fork Pound River	1976-79, 2006-2007	26 10	
PNS003.94		10/29/01	1	
USACOE Periodic Flow Measurements				
PNK001.01	North Fork Pound Lake	1995 - 2006		USACOE daily average flow, cfs

Table 2.1. (continued)

Type of Permit / Monitoring	Collection Period	No. of Sites	Description
Virginia DMME - DMLR Monitoring Data			
In-stream	01/95 – 09/06	28	Mining permit compliance monitoring
Groundwater	01/95 – 09/06	40	Mining permit compliance monitoring
VPDES Discharge	01/95 – 09/06	39	Bi-weekly effluent monitoring
Virginia DMME - DGO Permit Summary			
Active well permits		31	
Plugged release wells		6	
305(b) Monitored Exceedences			
PLL000.17	2004		
PNK000.08	1998, 2000, 2002, 2004		Summary of biennial water quality exceedences.
PNS000.40	1998, 2000, 2002, 2004		
PNS003.94	2004		
PNS004.98	2002, 2004		
PNS008.73	2002, 2004		
VADEQ Permitted Point Sources			
1000-gpd General Permits		4	Households with domestic sewage discharges to surface waters.
Construction Stormwater Permits		0	Active construction in the watershed.
VPDES Permits		0	Active VPDES point dischargers in NF/SF Pound River.
Industrial Stormwater Permits		0	Monthly effluent monitoring of flow and TSS.
Ancillary Data			
VADCR Watershed NPS Pollutant Ratings			Biennial ratings of N, P and sediment by state 14-digit watersheds.

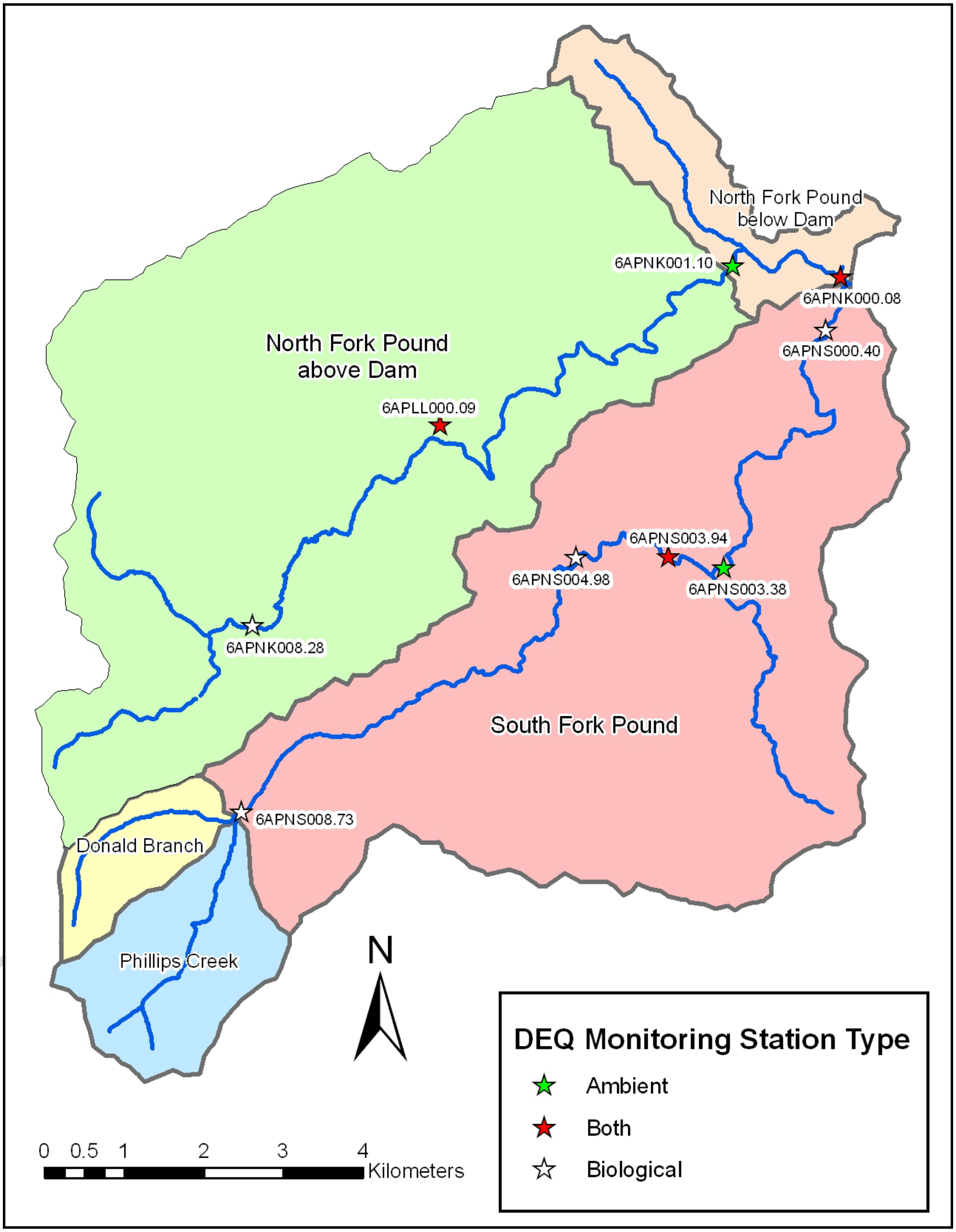

Figure 2.1. DEQ Monitoring Sites on North Fork and South Fork Pound River

2.1. DEQ Benthic Data

- Biological monitoring data was obtained from an April 2006 version of Virginia's Environmental Data Analysis System (EDAS) database and from field sheets and spreadsheets from VADEQ-SWRO for the most recent samples.
- The dominant species of benthic macroinvertebrates at the North Fork Pound sites has included one less tolerant family – Heptageniidae – as well as two pollution-tolerant groups – Chironomidae and Hydropsychidae (Table 3); while the dominant species at the South Fork Pound sites has been predominantly Chironimidae and Hydropsychidae – the more pollutant-tolerant groups.

The taxa inventories for the North Fork Pound River stations are shown in Table 2.2, and for the South Fork Pound River sites in Table 2.3. Virginia Stream Condition Index (VaSCI) metrics, values and scores are given in Table 2.4, together with a graph of sample scores in Figure 2.2.

Table 2.2. Individual Taxa Inventory for North Fork Pound River

Taxa	Tolerance Value	Functional Family Group	Habit	North Fork Pound River Stations and Collection Dates																	
				PLL000.17	PNK000.08																PNK008.28
				06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
Glossosomatidae		Scraper	clinger																		
Leuctridae		Shredder		5															1		
Rhyacophilidae		Predator	clinger																		
Capniidae	1	Shredder																			3
Gomphidae	1	Predator	burrower											2			2				
Perlidae	1	Predator	clinger	6																	2
Athericidae	2	Predator	sprawler																		
Isonychiidae	2	Filterer	swimmer									11	4	5	3					11	
Leptophlebiidae	2	Collector	swimmer					1													
Nemouridae	2	Shredder	sprawler			2							47						15		
Perlodidae	2	Predator	clinger			4		1													5
Taeniopterygidae	2	Shredder	sprawler						39	3	2			63		41				40	9
Aeshnidae	3	Predator	climber				1														
Philopotamidae	3	Collector	clinger	23	2	1			1	7		4	2	5				3			
Tipulidae	3	Shredder	burrower	3	1			1		3	1	13		2				1			1
Uenoidae	3	Scraper	clinger																		7
Baetidae	4	Collector	swimmer	24		6		3								3			11		3
Caenidae	4	Collector	sprawler																		
Elmidae	4	Scraper	clinger	14							1	1		1		3	4	7	8	17	2
Ephemerellidae	4	Collector	clinger			38	1	1					4		4			2	1		
Heptageniidae	4	Scraper	clinger		22	2	36	5	24	27	3	43	5	6	2	31	37	42	1	1	2
Leptoceridae	4	Collector						5													
Psephenidae	4	Scraper	clinger	7																	
Sialidae	4	Predator	burrower																		
Cambaridae	5	Shredder		1							1										
Corydalidae	5	Predator	clinger	2		1	2	1				1		1		2			1		1
Hydrachnidae	5	Predator																			
Ceratopogonidae	6	Predator	burrower																		
Chironomidae (A)	6	Collector		6	6	8		14	3		11		29	4	18	9	10		28	7	32
Empididae	6	Predator	sprawler					1			2				1						1
Hydropsychidae	6	Filterer	clinger	7	64	39	47	9	25	36	3	21		7		15	29	46	4	26	22
Hydroptilidae	6	Scraper	clinger																		
Simuliidae	6	Filterer	clinger					48	4	1	3			2	4		3		22	3	1
Veliidae	6	Predator	skater																		
Haliplidae	7	Shredder	climber					1					2								
Planorbidae	7	Scraper																	3		
Corbiculidae	8	Filterer	sprawler			2	2	2	1	3	5	2		1	5		1	3	1	4	
Lumbriculidae	8	Collector			1			5		2	1	1							6		
Naididae	8	Collector	burrower				1														
Physidae	8	Scraper									1	1									
Sphaeriidae	8	Filterer	sprawler		1																
Psychodidae	10	Collector	burrower																		
Tubificidae	10	Collector	burrower			1				1											
Oligoneuriidae					15		16	2	9	15						1	9	7			
No. of Species				**11**	**8**	**11**	**8**	**16**	**8**	**10**	**12**	**10**	**7**	**12**	**7**	**8**	**8**	**8**	**13**	**8**	**14**
Total Abundance				**98**	**112**	**104**	**106**	**100**	**106**	**98**	**34**	**98**	**93**	**99**	**37**	**105**	**95**	**111**	**102**	**109**	**91**

- Dominant 2 organisms in each sample.

Additional Benthic Metrics																		
Scraper/Filterer-Collector		0.35	0.30	0.02	0.71	0.06	0.71	0.54	0.22	1.15	0.13	0.29	0.06	1.26	0.95	0.91	0.16	0.35	0.19
%Filterer-Collector		61.2%	66.1%	91.3%	48.1%	88.0%	32.1%	51.0%	67.6%	39.8%	41.9%	24.2%	91.9%	25.7%	45.3%	48.6%	71.6%	46.8%	63.7%
%Haptobenthos		60.2%	78.6%	81.7%	81.1%	65.0%	50.9%	72.4%	29.4%	71.4%	11.8%	22.2%	27.0%	48.6%	76.8%	90.1%	36.3%	43.1%	46.2%
%Shredder		9.2%	0.9%	1.9%		2.0%	36.8%	6.1%	11.8%	13.3%	52.7%	65.7%		39.0%		0.9%	15.7%	36.7%	14.3%
Field Measurements																		
temperature	(°C)	15.6								17.7	7.6	12.7	15.1				13.8	8.6	11
DO	(mg/L)	8.87								9	12.2	9.7	9.9				9.6	11.3	12.72
conductivity	(µS/cm)	30								180	60	110	100				82.8	109	160
pH		8.7								7	6.9	6.4	6.7				7.8	7.5	6.94

Table 2.3. Individual Taxa inventory for South Fork Pound River

Taxa	Tolerance Value	Functional Family Group	Habit	South Fork Pound River Stations and Collection Dates																							
				PNS000.40																PNS003.94		PNS004.98			PNS008.73		
				10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
Glossosomatidae		Scraper	clinger					1																			
Leuctridae		Shredder																									
Rhyacophilidae		Predator	clinger			1																					
Capniidae	1	Shredder						5					2						3					2			
Gomphidae	1	Predator	burrower														1										
Perlidae	1	Predator	clinger																				3				
Athericidae	2	Predator	sprawler										1		2		16		1	1	3						
Isonychiidae	2	Filterer	swimmer																								
Leptophlebiidae	2	Collector	swimmer																								
Nemouridae	2	Shredder	sprawler		6							2						2									
Perlodidae	2	Predator	clinger																								
Taeniopterygidae	2	Shredder	sprawler					25	4				60		33		7		8								
Aeshnidae	3	Predator	climber																								
Philopotamidae	3	Collector	clinger			4		1			5		2	1	3				3					3			
Tipulidae	3	Shredder	burrower	1		4					2									2			4	4			2
Uenoidae	3	Scraper	clinger																								
Baetidae	4	Collector	swimmer	4	14	6			1		4																
Caenidae	4	Collector	sprawler																1								
Elmidae	4	Scraper	clinger	1	1	1	3	4	1		13	5	10	19	3	22	8	4	6	46	64	36	1	3			
Ephemerellidae	4	Collector	clinger																				1				
Heptageniidae	4	Scraper	clinger				1																				
Leptoceridae	4	Collector																									
Psephenidae	4	Scraper	clinger														1	1									
Sialidae	4	Predator	burrower																						1		
Cambaridae	5	Shredder									1																
Corydalidae	5	Predator	clinger	2		1	3	2	4	1	3			2			2					1		1		3	
Hydrachnidae	5	Predator																						1			
Ceratopogonidae	6	Predator	burrower																				5		1		
Chironomidae (A)	6	Collector		3	10	2	11	9	4	16	5	20	8	27	19	5	4	58	18	23	1	17	60	26	103	77	71
Empididae	6	Predator	sprawler									3	6				3	7	4		2		13	4		1	1
Hydropsychidae	6	Filterer	clinger	93	55	83	17	48	99	3	17	28	21	41	49	79	71	19	48	23	26	45	2	61	2		4
Hydroptilidae	6	Scraper	clinger																1				1				
Simuliidae	6	Filterer	clinger		19						5		3		3	5	2	1								10	24
Veliidae	6	Predator	skater																	1							
Haliplidae	7	Shredder	climber																								
Planorbidae	7	Scraper				1																					
Corbiculidae	8	Filterer	sprawler													1	2	1	12								
Lumbriculidae	8	Collector					1							2			2		1				3		2		1
Naididae	8	Collector	burrower																1				1			1	
Physidae	8	Scraper																									
Sphaeriidae	8	Filterer	sprawler																								3
Psychodidae	10	Collector	burrower																							1	
Tubificidae	10	Collector	burrower	1														1									
Oligoneuriidae						8			1		3																
No. of Species				**7**	**6**	**10**	**6**	**8**	**7**	**3**	**10**	**5**	**9**	**6**	**7**	**5**	**12**	**9**	**13**	**6**	**5**	**4**	**11**	**9**	**5**	**6**	**7**
Total Abundance				**105**	**105**	**111**	**36**	**95**	**114**	**20**	**58**	**58**	**113**	**92**	**112**	**112**	**119**	**94**	**107**	**96**	**96**	**99**	**94**	**105**	**109**	**93**	**106**

- Dominant 2 organisms in each sample.

Additional Benthic Metrics

Scraper/Filterer-Collector		0.01	0.01	0.02	0.14	0.09	0.01		0.36	0.10	0.29	0.27	0.04	0.24	0.11	0.06	0.08	1.00	2.37	0.58	0.03	0.03			
%Filterer-Collector		96.2%	93.3%	85.6%	80.6%	61.1%	91.2%	95.0%	62.1%	82.8%	30.1%	77.2%	66.1%	80.4%	68.1%	85.1%	78.5%	47.9%	28.1%	62.6%	71.3%	85.7%	98.2%	95.7%	97.2%
%Haptobenthos		91.4%	71.4%	81.1%	66.7%	58.9%	91.2%	20.0%	74.1%	56.9%	31.9%	68.5%	51.8%	94.6%	70.6%	26.6%	54.2%	71.9%	93.8%	82.8%	8.5%	64.8%	1.8%	14.0%	26.4%
%Shredder		1.0%	5.7%	3.6%		31.6%	3.5%		5.2%	3.4%	54.9%		29.5%		5.9%	2.1%	10.3%	2.1%			4.3%	5.7%			1.9%
Field Measurements																									
temperature	(°C)								12.5	8.7	7.4	15.3				15.1	8.9	18.05	6.39		14.7	10.8		13.7	12.5
DO	(mg/L)								9.8	11.7	11.1	9.7				9.3	11.2	10.07	10.83		9.3	10.5		7.5	7.4
conductivity	(µS/cm)								1100	750	1200	1100				1452	1624	2006	1778		1782	1913		1972	2060
pH									7	6.8	7.6	7.7				8.1	8.1	8.1	7.89		8.1	8.1		7.3	7.3

Table 2.4. Virginia Stream Condition (VaSCI) Data – North Fork and South Fork Pound Rivers

	North Fork Pound River Stations and Collection Dates																	
	6APLL000.17	PNK000.08																PNK008.28
	06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
VaSCI Metrics																		
TotTaxa	11	8	11	8	16	8	10	12	10	7	12	7	8	8	8	13	8	14
EPTTax	5	4	7	4	8	5	5	3	4	5	5	3	5	3	5	6	4	8
%Ephem	24.5	19.6	44.2	34.9	9.0	22.6	27.6	8.8	55.1	14.0	11.1	24.3	32.4	38.9	39.6	12.75	11	5.5
%PT - Hydropsychidae	34.7	1.8	6.7	0.0	1.0	37.7	10.2	5.9	4.1	52.7	68.7	0.0	39.0	0.0	2.7	15.69	36.7	28.6
%Scrap	21.4	19.6	1.9	34.0	5.0	22.6	27.6	14.7	45.9	5.4	7.1	5.4	32.4	43.2	44.1	11.76	16.5	12.1
%Chiro	6.1	5.4	7.7	0.0	14.0	2.8	0.0	32.4	0.0	31.2	4.0	48.6	8.6	10.5	0.0	27.45	6.42	35.2
%2Dom	48.0	76.8	74.0	78.3	62.0	60.4	64.3	47.1	65.3	81.7	70.7	62.2	68.6	69.5	79.3	49.02	60.6	59.3
MFBI	3.6	5.0	4.9	4.7	5.6	3.7	4.6	5.8	4.2	3.6	2.8	5.6	3.7	4.7	4.8	4.917	3.87	4.7
VaSCI Metric Scores																		
TotTaxa	50.0	36.4	50.0	36.4	72.7	36.4	45.5	54.5	45.5	31.8	54.5	31.8	36.4	36.4	36.4	59.09	36.4	63.6
EPTTax	45.5	36.4	63.6	36.4	72.7	45.5	45.5	27.3	36.4	45.5	45.5	27.3	45.5	27.3	45.5	54.55	36.4	72.7
%Ephem	40.0	32.0	72.2	56.9	14.7	36.9	44.9	14.4	89.9	22.8	18.1	39.7	52.8	63.5	64.7	20.79	18	9.0
%PT - Hydropsychidae	97.5	5.0	18.9	0.0	2.8	100.0	28.7	16.5	11.5	100.0	100.0	0.0	100.0	0.0	7.6	44.06	100	80.3
%Scrap	41.5	38.1	3.7	65.8	9.7	43.9	53.4	28.5	89.0	10.4	13.7	10.5	62.8	83.6	85.6	22.8	32	23.4
%Chiro	93.9	94.6	92.3	100.0	86.0	97.2	100.0	67.6	100.0	68.8	96.0	51.4	91.4	89.5	100.0	72.55	93.6	64.8
%2Dom	75.2	33.5	37.5	31.4	54.9	57.3	51.6	76.5	50.1	26.4	42.3	54.7	45.4	44.1	29.9	73.67	57	58.8
%MFBI	93.5	73.1	74.7	77.8	64.1	92.2	80.1	61.5	85.3	94.6	100.0	64.4	92.9	78.4	76.9	74.75	90.1	78.2
VaSCI Total Scores	**67.1**	**43.6**	**51.6**	**50.6**	**47.2**	**63.7**	**56.2**	**43.4**	**63.4**	**50.0**	**58.8**	**35.0**	**65.9**	**52.8**	**55.8**	**52.8**	**57.9**	**56.4**

	South Fork Pound River Stations and Collection Dates																							
	PNS000.40																6APNS003.94		PNS004.98			PNS008.73		
	10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
VaSCI Metrics																								
TotTaxa	7	6	10	6	8	7	3	10	5	9	6	7	5	12	9	13	6	5	4	11	9	5	6	7
EPTTax	2	3	5	2	5	4	1	4	2	4	2	3	1	2	2	6	1	1	1	4	3	1		1
%Ephem	3.8	13.3	5.4	2.8	0.0	0.9	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0	0.93	0.0	0.0	0.0	1.064	0	0.0	0	0
%PT - Hydropsychidae	0.0	5.7	3.6	0.0	32.6	3.5	0.0	8.6	3.4	56.6	1.1	32.1	0.0	5.9	2.128	14	0.0	0.0	0.0	4.255	4.762	0.0		
%Scrap	1.0	1.0	1.8	11.1	5.3	0.9	0.0	22.4	8.6	8.8	20.7	2.7	19.6	7.6	5.319	6.54	47.9	66.7	36.4	2.128	2.857	0.0	0	0
%Chiro	2.9	9.5	1.8	30.6	9.5	3.5	80.0	8.6	34.5	7.1	29.3	17.0	4.5	3.4	61.7	16.8	24.0	1.0	17.2	63.83	24.76	94.5	82.8	67
%2Dom	92.4	70.5	80.2	77.8	76.8	90.4	95.0	51.7	82.8	71.7	73.9	73.2	90.2	73.1	81.91	61.7	71.9	93.8	81.8	77.66	82.86	96.3	93.5	89.6
MFBI	5.9	5.5	5.3	5.8	4.5	5.8	6.0	4.8	5.7	3.5	5.6	4.6	5.6	5.1	5.828	5.55	4.9	4.5	5.3	5.681	5.629	6.0	6.03	6
VaSCI Metric Scores																								
TotTaxa	31.8	27.3	45.5	27.3	36.4	31.8	13.6	45.5	22.7	40.9	27.3	31.8	22.7	54.5	40.91	59.1	27.3	22.7	18.2	50	40.91	22.7	27.3	31.8
EPTTax	18.2	27.3	45.5	18.2	45.5	36.4	9.1	36.4	18.2	36.4	18.2	27.3	9.1	18.2	18.18	54.5	9.1	9.1	9.1	36.36	27.27	9.1	0	9.09
%Ephem	6.2	21.8	8.8	4.5	0.0	1.4	0.0	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0	1.52	0.0	0.0	0.0	1.735	0	0.0	0	0
%PT - Hydropsychidae	0.0	16.1	10.1	0.0	91.7	9.9	0.0	24.2	9.7	100.0	3.1	90.3	0.0	16.5	5.977	39.4	0.0	0.0	0.0	11.95	13.38	0.0	0	0
%Scrap	1.8	1.8	3.5	21.5	10.2	1.7	0.0	43.4	16.7	17.2	40.0	5.2	38.1	14.7	10.31	12.7	92.9	100.0	70.5	4.123	5.537	0.0	0	0
%Chiro	97.1	90.5	98.2	69.4	90.5	96.5	20.0	91.4	65.5	92.9	70.7	83.0	95.5	96.6	38.3	83.2	76.0	99.0	82.8	36.17	75.24	5.5	17.2	33
%2Dom	11.0	42.7	28.6	32.1	33.5	13.9	7.2	69.8	24.9	40.9	37.7	38.7	14.2	38.9	26.13	55.4	40.6	9.0	26.3	32.28	24.77	5.3	9.32	15
%MFBI	60.3	66.3	68.8	62.5	81.2	62.5	59.6	76.9	63.4	95.3	65.0	79.1	64.4	72.4	61.35	65.5	74.4	80.3	69.6	63.51	64.29	59.4	58.3	58.8
VaSCI Total Scores	**28.3**	**36.7**	**38.6**	**29.4**	**48.6**	**31.8**	**13.7**	**49.8**	**27.6**	**52.9**	**32.7**	**44.4**	**30.5**	**39.0**	**25.1**	**46.4**	**40.0**	**40.0**	**34.6**	**29.5**	**31.4**	**12.8**	**14.0**	**18.5**

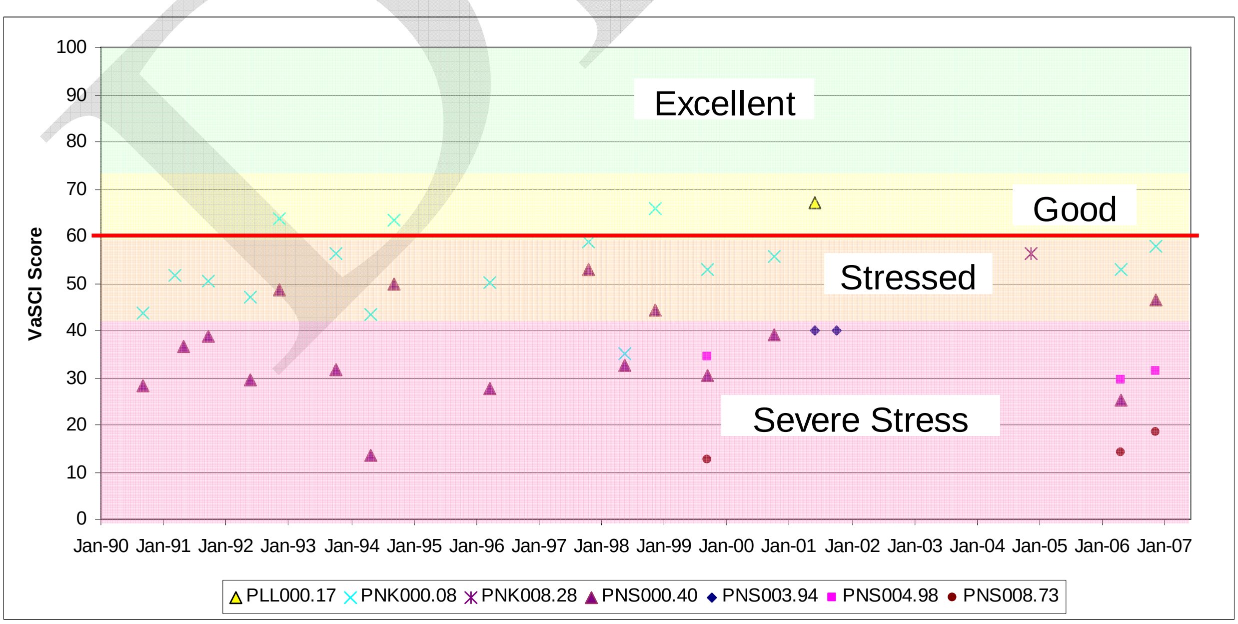

Figure 2.2. VaSCI Ratings for All Stations, 1990 - 2006

2.2. DEQ Habitat Data

- Habitat data collected as part of the biological monitoring were also obtained from DEQ through the EDAS database for historical samples and from field worksheets for more recent samples (Table 2.5 and Table 2.6).
- Historically, many habitat metrics have received "poor" to "marginal" habitat scores at all of the North Fork and South Fork Pound River sites, with slightly lower scores at the South Pound sites.
- A slight increasing trend is apparent in the cumulative graph of total habitat scores shown in Figure 2.3.

Table 2.5. Habitat Evaluation Summary for North Fork Pound River and Phillips Creek

Habitat Metrics		North Fork Pound River Stations and Collection Dates																	
	StationID	PLL000.17	PNK000.08																PNK008.28
	Collection Date	06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
Channel Alteration	ALTER	19	11	14	9	13	12	12	18	17	18	15	16	17	17	16	18	17	18
Bank Stability	BANKS	15	8	10	13	10	8	4	12	10	7	8	11	6	11	7	10	11	9
Bank Vegetation	BANKVEG	18	10	10	14	14	11	7	18	14	18	16	18	18	16	15	17	17	14
Embeddedness	EMBED	15	13	10	5	7	13	12	12	12	9	9	7	6	5	7	7	5	15
Channel Flow Status	FLOW	14	0	12	14	13	10	2	13	18	19	19	18	8	8	13	19	18	19
Frequency of Riffles	RIFFLES	18	10	10	8	8	8	8	10	13	10	10	12	9	6	10	11	16	16
Riparian Vegetation	RIPVEG	14	8	16	15	13	10	4	7	10	13	7	11	7	11	10	16	17	14
Sediment Deposition	SEDIMENT	12	8	13	8	9	8	9	11	14	12	16	7	7	4	15	7	7	13
Substrate Availability	SUBSTRATE	16	17	17	14	16	18	12	16	16	13	12	16	15	6	15	14	16	16
Velocity/Depth Regime	VELOCITY	10	10	13	12	11	13	16	10	15	13	11	13	9	7	15	13	9	10
10-Metric Total		151	95	125	112	114	111	86	127	139	132	123	129	102	91	123	132	133	144

Habitat metric score assessed as "marginal" or "poor".

Table 2.6. Habitat Evaluation Summary for South Fork Pound River

Habitat Metrics		South Fork Pound River Stations and Collection Dates																									
	StationID	PNS000.40																PNS003.94		PNS004.98			PNS008.73		
	Collection Date	10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
Channel Alteration	ALTER	12	6	8	5	8	7	10	11	12	13	17	17	16	12	16	18	17	18	17	18	18	18	18	17
Bank Stability	BANKS	9	8	11	11	9	4	11	9	7	6	7	4	6	7	11	11	14	14	4	8	7	4	10	13
Bank Vegetation	BANKVEG	9	11	13	12	10	7	10	14	13	17	18	17	15	7	10	14	12	11	15	12	10	17	12	14
Embeddedness	EMBED	12	7	11	7	12	12	5	9	7	2	12	4	13	12	9	14	10	7	6	7	8	10	9	7
Channel Flow Status	FLOW	0	14	13	13	12	6	16	12	18	17	19	9	8	13	17	17	11	11	8	19	18	9	16	16
Frequency of Riffles	RIFFLES	8	9	7	5	7	7	7	12	7	7	7	9	7	7	9	11	12	13	6	10	6	11	18	8
Riparian Vegetation	RIPVEG	7	11	10	11	8	2	6	6	9	7	7	7	7	7	8	11	12	10	4	10	11	16	12	13
Sediment Deposition	SEDIMENT	8	9	7	8	7	7	15	12	9	6	7	15	10	7	7	11	5	5	3	6	9	10	15	15
Substrate Availability	SUBSTRATE	19	16	17	12	18	7	17	16	15	15	15	15	14	16	16	17	13	16	6	7	12	17	13	6
Velocity/Depth Regime	VELOCITY	9	11	11	6	12	7	15	14	16	13	6	14	10	14	15	9	16	10	7	14	15	9	10	10
10-Metric Total		93	102	108	90	103	66	112	115	113	103	115	111	106	102	118	133	122	115	76	111	114	121	133	119

Habitat metric score assessed as "marginal" or "poor".

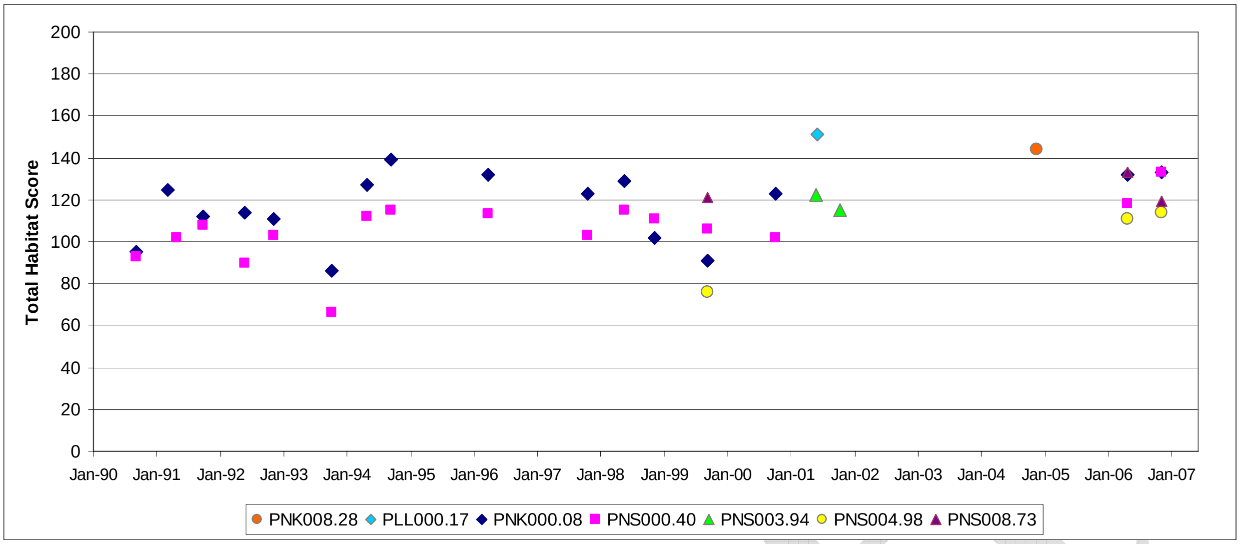

Figure 2.3. Total Habitat Scores by Station

2.3. DEQ Ambient Data

- The North Fork Pound River impaired segment has been monitored by the PNK000.08 biological station since 1990, with ambient sample collection only recently started at the same site in August 2006. A second ambient station just below the mixing zone of the outfall from the North Fork Pound Dam (PNK001.10) was initiated this spring.
- The South Fork Pound River impaired segment has its longest record of biological monitoring from station PNS000.40, with ambient sampling from station PNS003.38.
- The Phillips Creek and Donald Branch impaired segments were monitored by biological station PNS008.73 in 1999 and twice in 2006. No corresponding ambient data is available near this station except for DMLR compliance monitoring.
- A 7-year gap occurred in DEQ biological monitoring in these watersheds between 1999 and 2006, and about a 26-year gap in ambient monitoring. A few of the ambient parameters are compared in Table 2.7 between recent sampling at the primary North Fork and South Fork ambient stations, and also before and after the monitoring gap at the South Fork site.
- Nutrient data is summarized in Table 2.8 to assist in assessing nutrient influences in these watersheds. Note the marked difference in TKN/TN ratios between the North Fork and South Fork stations, indicating a larger fraction of nitrogen coming from organic sources in North Fork, even though the TKN concentrations are comparable.

Table 2.7. Comparison of Ambient Parameter Concentrations: 1976-1979 and 2006-2007

Parameter Name	Units	PNK000.08	PNK001.10	PNS003.38	
		2006-07	2006-07	1976-79	2006-07
Total Solids	(mg/L)	86.50	69.00	678.47	1,553.80
Volatile Solids	(mg/L)	20.30	15.67	129.11	183.40
Fixed Solids	(mg/L)	66.20	53.33	553.42	1,370.40
Total Dissolved Solids	(mg/L)	0.00	0.00	327.00	--
RESIDUE, VOLATILE FILTRABLE	(mg/L)	17.00	10.00	--	113.10
RESIDUE, FIXED FILTRABLE	(mg/L)	60.50	53.00	--	1,369.20
RESIDUE, TOTAL NONFILTRABLE	(mg/L)	4.10	3.33	242.11	3.40
Volatile Suspended Solids	(mg/L)	3.00	3.00	28.17	3.00
Fixed Suspended Solids	(mg/L)	3.80	3.00	226.53	3.20
SETTLEABLE SOLIDS VOLUMETRIC		0.19	0.19	--	2.15
NITROGEN, AMMONIA, DISSOLVED	(mg/L)	0.050	0.053	--	0.050
AMMONIA, TOTAL	(mg/L)	0.040	0.040	0.115	0.040
NITRITE NITROGEN, TOTAL	(mg/L)	0.000	0.000	0.013	--
NITRATE NITROGEN, DISSOLVED	(mg/L)	0.089	0.107	--	2.155
NITRATE, TOTAL	(mg/L)	0.000	0.000	--	--
NITROGEN, TOTAL KJELDAHL	(mg/L)	0.120	0.133	0.158	0.100
NITRITE + NITRATE, TOTAL	(mg/L)	0.096	0.107	0.732	2.072
Total Phosphorus	(mg/L)	0.011	0.017	--	0.011
PHOSPHORUS, DISSOLVED	(mg/L)	0.050	0.050	--	0.050
CARBON, TOTAL ORGANIC	(mg/L)	2.06	2.00	--	2.05
CARBON, ORGANIC, IN BED MATERIAL	(g/kg)	9.07	6.58	--	182.00
CARBON, ORGANIC, IN BED MATERIAL	(g/kg)	5.43	4.05	--	136.60
CARBON, ORGANIC, IN BED MATERIAL	(g/kg)	2.61	2.23	--	104.56
CARBON, ORGANIC, IN BED MATERIAL	(g/kg)	0.98	0.89	--	6.35
Chloride	(mg/L)	2.32	1.62	3.00	3.04
CHLORIDE, DISSOLVED IN WATER	(mg/L)	5.00	5.00	--	5.00
SULPHATE, TOTAL	(mg/L)	34.53	25.13	241.44	870.20
SULPHATE, TOTAL	(mg/L)	34.27	25.33	--	871.00

Table 2.8. Nutrient Concentration Averages and TN:TP Ratio by Station

Station	Period	No. of Samples	PO4-P (mg/L)	TP (mg/L)	NO2+NO3 (mg/L)	TN (mg/L)	TN/TP	TKN/TN
PLL000.09	1972-1976	16	0.076	0.100	0.07	0.20	2.0	0.66
PNK000.08	2006-2007	10	0.050	0.011	0.10	0.19	17.6	0.62
PNK001.10	2007	3	0.050	0.017	0.11	0.19	11.6	0.69
PNS003.94	2001	1		0.010	0.92	1.02	102.0	0.10
PNS003.38	1976-1979	25	--	--	0.73	0.89		0.18
PNS003.38	2006-2007	10	0.050	0.011	2.07	2.15	195.0	0.05

- Plots of monthly ambient water quality monitoring sample data are shown in Figures 2.4 through 2.19 for the 3 current monitoring stations in these watersheds. Where available, monitoring data are also included from a station further downstream on the Pound River (PNR035.66) for perspective.

- Chemical parameters include various forms of nitrogen and phosphorus – ammonia-N, TKN, nitrite plus nitrate-N, and total P; dissolved oxygen; various forms of solids – total solids, volatile solids, and suspended solids; alkalinity; chlorides; sulfates; and manganese. Although total dissolved solids (TDS) are a parameter of concern in mining regions, no recent DEQ monitoring was available for this parameter. Field physical parameters included temperature, pH, dissolved oxygen (DO), and conductivity.
- Where applicable, minimum and/or maximum water quality standards are indicated on the plots. All stream segments within these watersheds are Class IV Mountainous Zone Waters, with the exception of the segment between the North Fork Pound Lake and the Town of Pound, which has a Class V(vi) classification as a Stockable Trout Stream (SWCB, 2006).

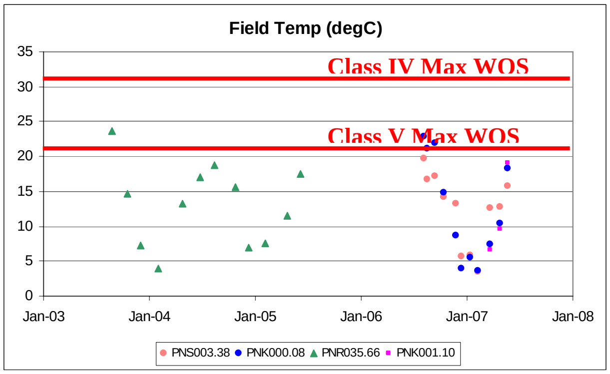

Figure 2.4. Field Temperature

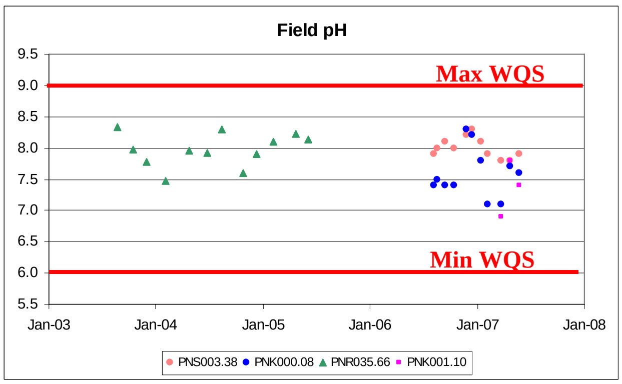

Figure 2.5. Field pH

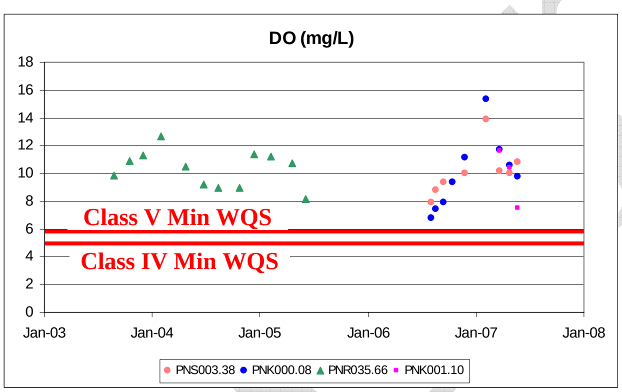

Figure 2.6. Field DO

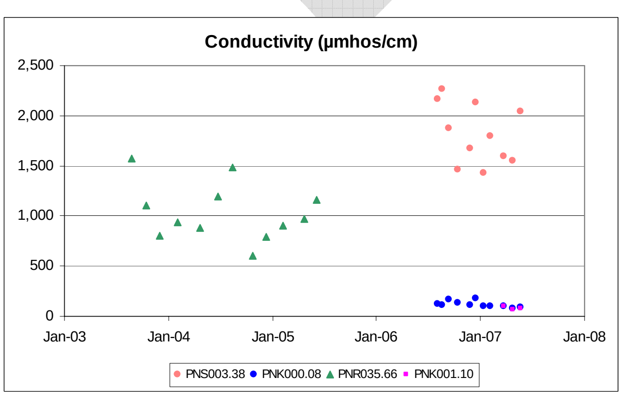

Figure 2.7. Field Conductivity

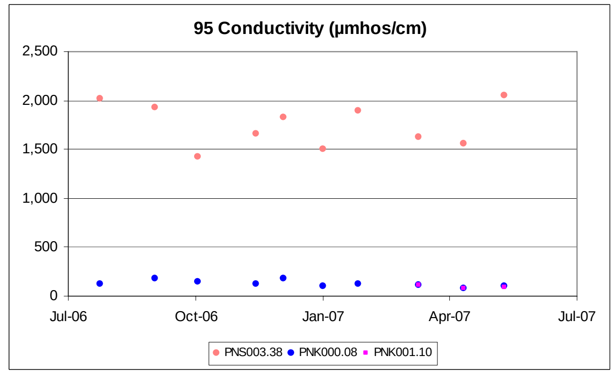

Figure 2.8. Lab Conductivity

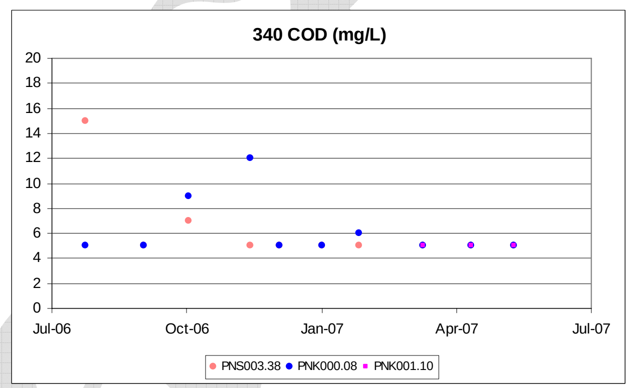

Figure 2.9. Lab COD

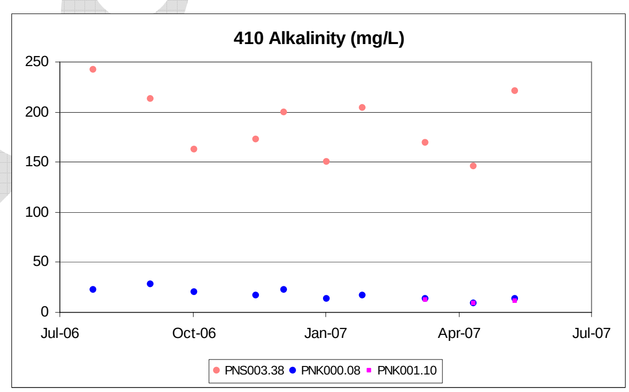

Figure 2.10. Alkalinity

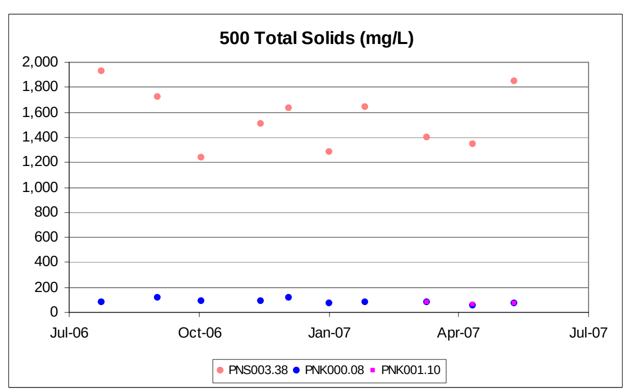

Figure 2.11. Total Solids

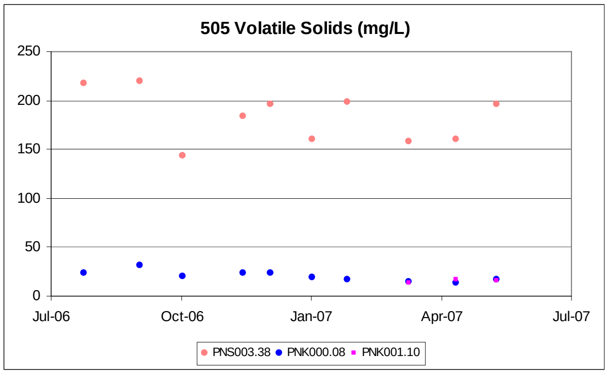

Figure 2.12. Volatile Solids

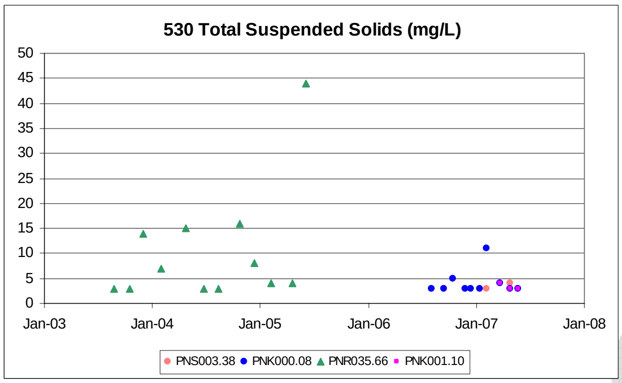

Figure 2.13. Suspended Solids

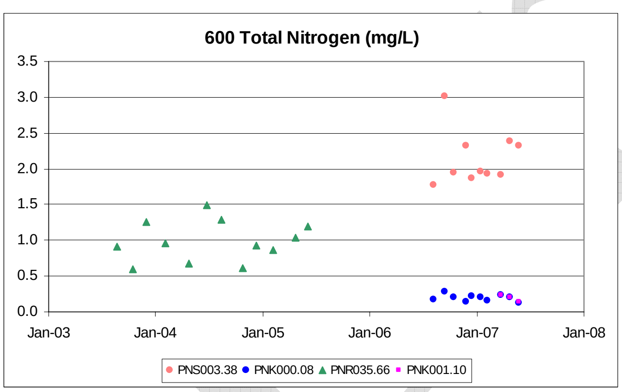

Figure 2.14. Total Nitrogen

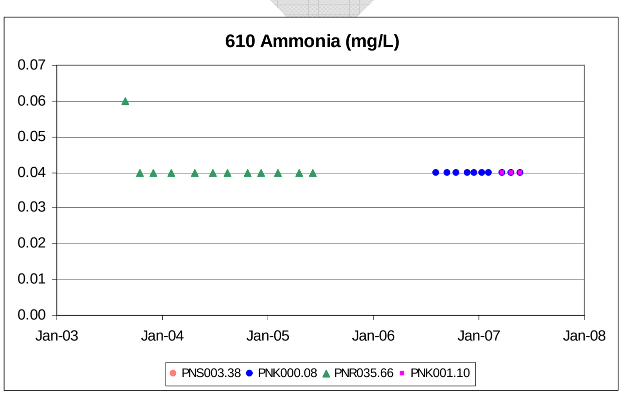

Figure 2.15. Ammonia

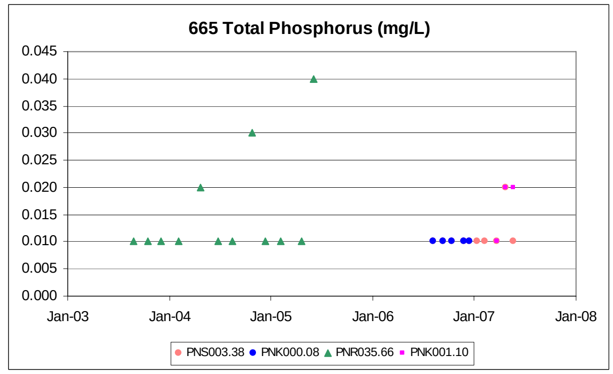

Figure 2.16. Total Phosphorus

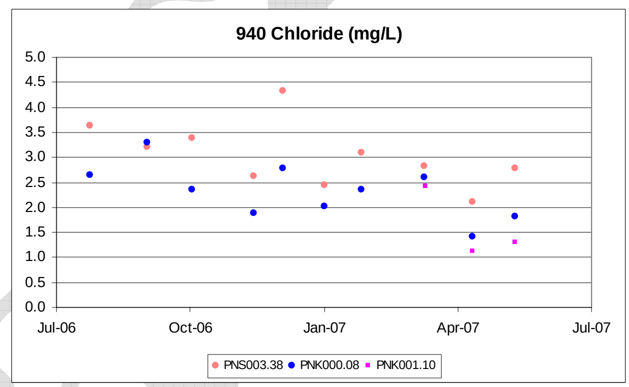

Figure 2.17. Chloride

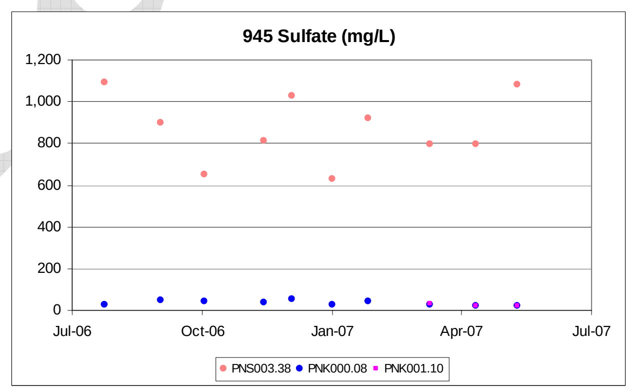

Figure 2.18. Sulfate

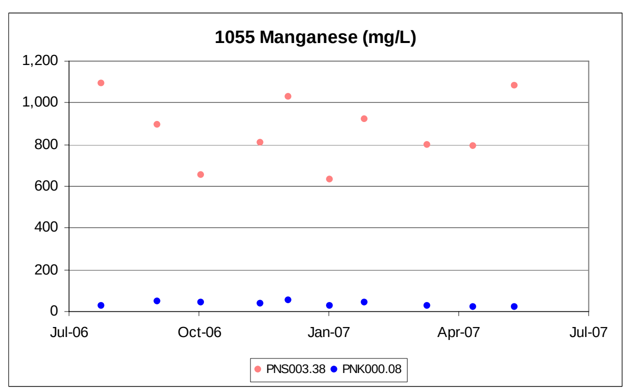

Figure 2.19. Manganese

2.4. Stream Sediment Tests for Metals

- Four sediment samples have been collected and analyzed for a standard suite of metals and toxic substances: three samples in the late 1990's and one earlier this year.
- None of the tested substances exceeded any known freshwater aquatic life or human health criteria, and many of the substances were not detected above their minimum detection limits, as shown in Table 2.9. However, nickel (Ni) was detected at a level above the consensus-based PEC; once in 2001, and again in 2006 at 2 different stations in the South Fork Pound watershed.

Table 2.9. DEQ Periodic Channel Bottom Sediment Monitoring for Metals

Parameter Name	Pgc Spc Param	Average Parameter Values Above MDL				Minimum Detection Limit	Consensus-Based PECs	Freshwater Aquatic Life Criteria~		Human Health Criteria~	
		6APLL000.09	6APNK000.08	6APNS003.38	6APNS003.94			Chronic (ug/L)	Acute (ug/L)	PWS (ug/L)	Other (ug/L)
ARSENIC, DISSOLVED (UG/L AS AS)	01000		0.3	0.2		0.1		150	340	10	
BARIUM, DISSOLVED (UG/L AS BA)	01005		22.2	21.3		10.0				2,000	
CADMIUM, TOTAL (UG/L AS CD)	01027			700							
CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY W	01029		5.9	6.3	6.7		111				
CHROMIUM, DISSOLVED (UG/L AS CR)	01030			0.2		0.1		74	540	100	
CHROMIUM, TOTAL (UG/L AS CR)	01034	15		700							
COPPER, DISSOLVED (UG/L AS CU)	01040		0.4	1.7		0.1		9	13	1,300	
COPPER, TOTAL (UG/L AS CU)	01042	10									
COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT	01043		7.2	8.9	8.0		149				
IRON, TOTAL (UG/L AS FE)	01045			1,904.9							
LEAD, TOTAL (UG/L AS PB)	01051			4.0							
LEAD, SEDIMENT (MG/KG AS PB DRY WT)	01052		7.2	6.9	7.5		128				
Manganese	01053		900	4,710	2,340						
MANGANESE, TOTAL (UG/L AS MN)	01055			2,255.0							
MANGANESE, DISSOLVED (UG/L AS MN)	01056		91.2	108.0		0.1				50	
NICKEL, DISSOLVED (UG/L AS NI)	01065		0.5	6.0		0.1		20	180	610	4,600
NICKEL, TOTAL (UG/L AS NI)	01067			700							
NICKEL, SEDIMENT (MG/KG DRY WT)	01068		10.3	53.9	52.0		48.6				
ZINC, DISSOLVED (UG/L AS ZN)	01090		1.0	5.5		1.0		120	120	9,100	69,000
ZINC, TOTAL (UG/L AS ZN)	01092	13.3		101.0							
ZINC, SEDIMENT (MG/KG AS ZN DRY WT)	01093		40.3	127.0	118		459				
ALUMINUM, DISSOLVED (UG/L AS AL)	01106		2.0	48.0		1.0					
Aluminum	01108		3,680	5,340	5,730						
SELENIUM, DISSOLVED (UG/L AS SE)	01145			2.8		0.5		5	20	170	11,000
Iron	01170		12,100	19,000	16,500						

Potential Stress PEC = probable effects concentration.
~ 9 VAC 25-260 Virginia Water Quality Standards. February 12, 2004.

2.5. DEQ VPDES Permits in North Fork and South Fork Pound River

- There are 4 general discharge permits for single-family homes in the watersheds, as shown in Figure 2.20.
- There are currently no active DEQ VPDES permits for construction or industrial stormwater, or other discharger permits in the watershed.

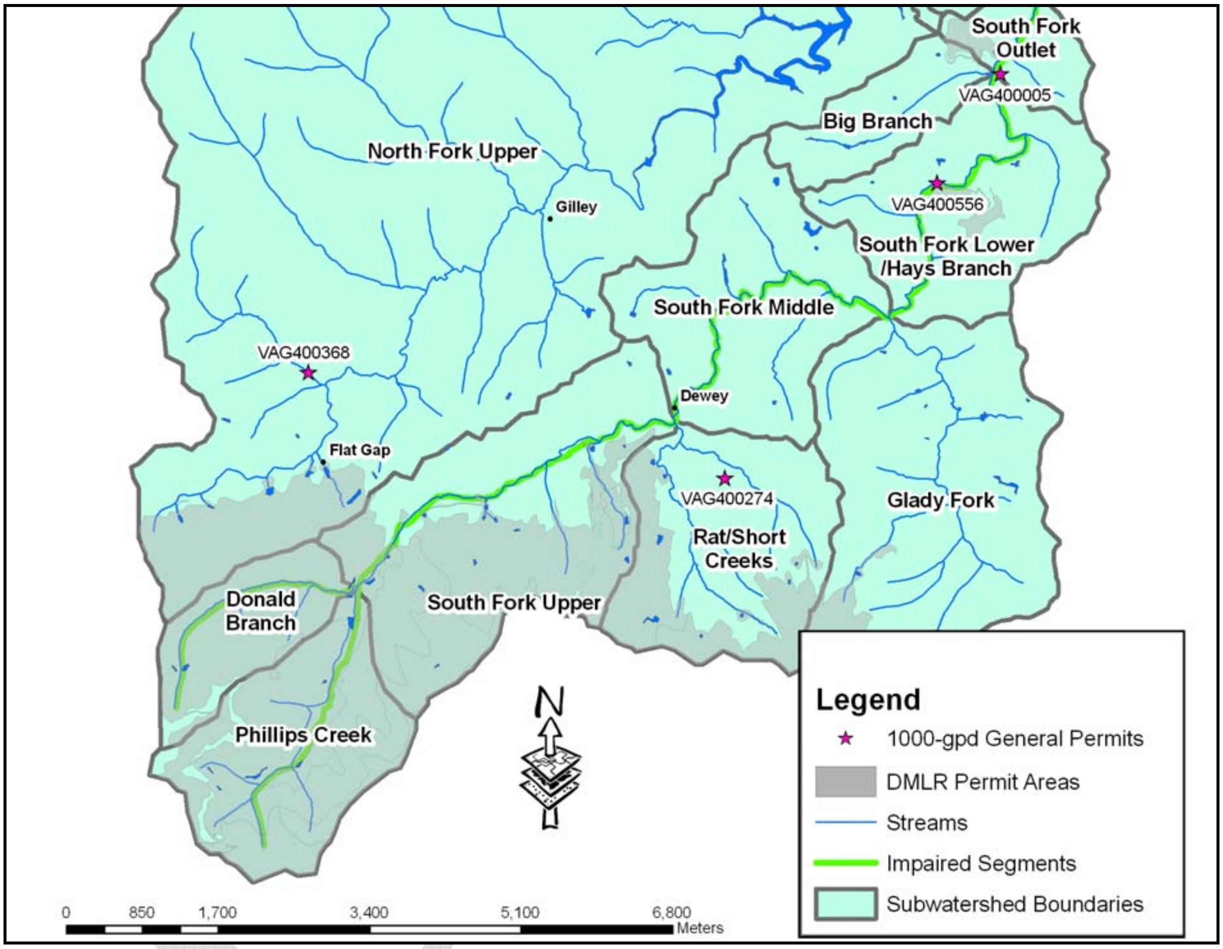

Figure 2.20. DEQ Permitted Point Source Dischargers

2.6. DMME-DMLR Monitoring Data

- A summary of the various coal mining permits is given in Table 2.10. Each mining permit will carry various requirements for monitoring their operations. Each permitted area will channel stormwater runoff through an NPDES sediment pond, although a pond may serve more than one permitted area. In-stream monitoring and groundwater monitoring are less permit-specific, so that each monitoring location may serve as compliance for multiple upstream permitted areas.

Table 2.10. DMLR Mining Permit Summary

Permit Number	Mining Operation Name	Community	Sub-watershed	Area (acres)
1100033	FOX GAP MINE	DIXIANA	Phillips Creek	78.7
1100033	FOX GAP MINE	DIXIANA	South Fork Upper	5.6
1100044	STEER BRANCH PREP PLANT-#2 STRIP	DIXIANA	Rat Creek	1.3
1100044	STEER BRANCH PREP PLANT-#2 STRIP	DIXIANA	South Fork Upper	0.8
1100520	H.E. #1 MINE	FLAT GAP	Phillips Creek	147.9
1100520	H.E. #1 MINE	FLAT GAP	South Fork Upper	194.2
1100717	BUCK KNOB MINE	DIXIANA	Glady Fork	188.1
1100717	BUCK KNOB MINE	DIXIANA	Rat Creek	217.0
1100787	UPPER PHILLIPS CREEK MINE	DIXIANA	Phillips Creek	222.9
1100787	UPPER PHILLIPS CREEK MINE	DIXIANA	South Fork Upper	215.0
1101102	MINE #2	DEWEY	South Fork Upper	30.9
1101102	MINE #2	DEWEY	South Fork Upper	15.4
1101270	FOUR LANE PERMIT	POUND	Big Branch	8.7
1101270	FOUR LANE PERMIT	POUND	South Fork Lower	41.1
1101272	FLAT GAP MINE	POUND	Donald Branch	558.5
1101272	FLAT GAP MINE	POUND	North Fork Upper	493.8
1101272	FLAT GAP MINE	POUND	Phillips Creek	23.0
1101272	FLAT GAP MINE	POUND	South Fork Upper	112.1
1101401	NORTH FOX GAP SURFACE MINE	POUND	Rat Creek	253.9
1101401	NORTH FOX GAP SURFACE MINE	POUND	South Fork Upper	538.9
1101565	HIGH SPLINT SURFACE MINE #2	DUNBAR	Donald Branch	16.6
1101565	HIGH SPLINT SURFACE MINE #2	DUNBAR	Phillips Creek	92.5
1101760	BACKBONE RIDGE SURFACE MINE	DIXIANA	Phillips Creek	143.2
1201187	PHILLIPS CREEK DEEP MINE	POUND	South Fork Upper	15.7
1201338	STILLHOUSE BRANCH MINE	DEWEY	South Fork Upper	31.2
1201664	PARSONS #1 MINE	ROARING FORK	Phillips Creek	0.1
1201664	PARSONS #1 MINE	ROARING FORK	Phillips Creek	0.8
1501778	STRAIGHT FORK SURFACE MINE	DUNBAR	Phillips Creek	1.6
1600876	WEST PHILLIPS CREEK MINE	FLAT GAP	Donald Branch	8.7
1600876	WEST PHILLIPS CREEK MINE	FLAT GAP	Phillips Creek	477.0
1600876	WEST PHILLIPS CREEK MINE	FLAT GAP	South Fork Upper	0.6
1601939	CENTURION MINE	POUND	South Fork Lower Middle	40.6

- The NPDES sediment ponds and in-stream monitoring locations are shown in Figure 2.21. The average parameter values between January 1996 and December 2006 for the North Fork Pound DMLR NPDES and in-stream monitoring points are shown respectively in Table 2.11 and Table 2.12; corresponding parameter averages are shown for the South Fork Pound River NPDES and in-stream monitoring points in Table 2.13 and Table 2.14, respectively. The following relative values were used to indicate higher concentrations: conductivity (> 500 μmhos/cm); TDS (> 500 mg/L); and sulfates (> 250 mg/L).

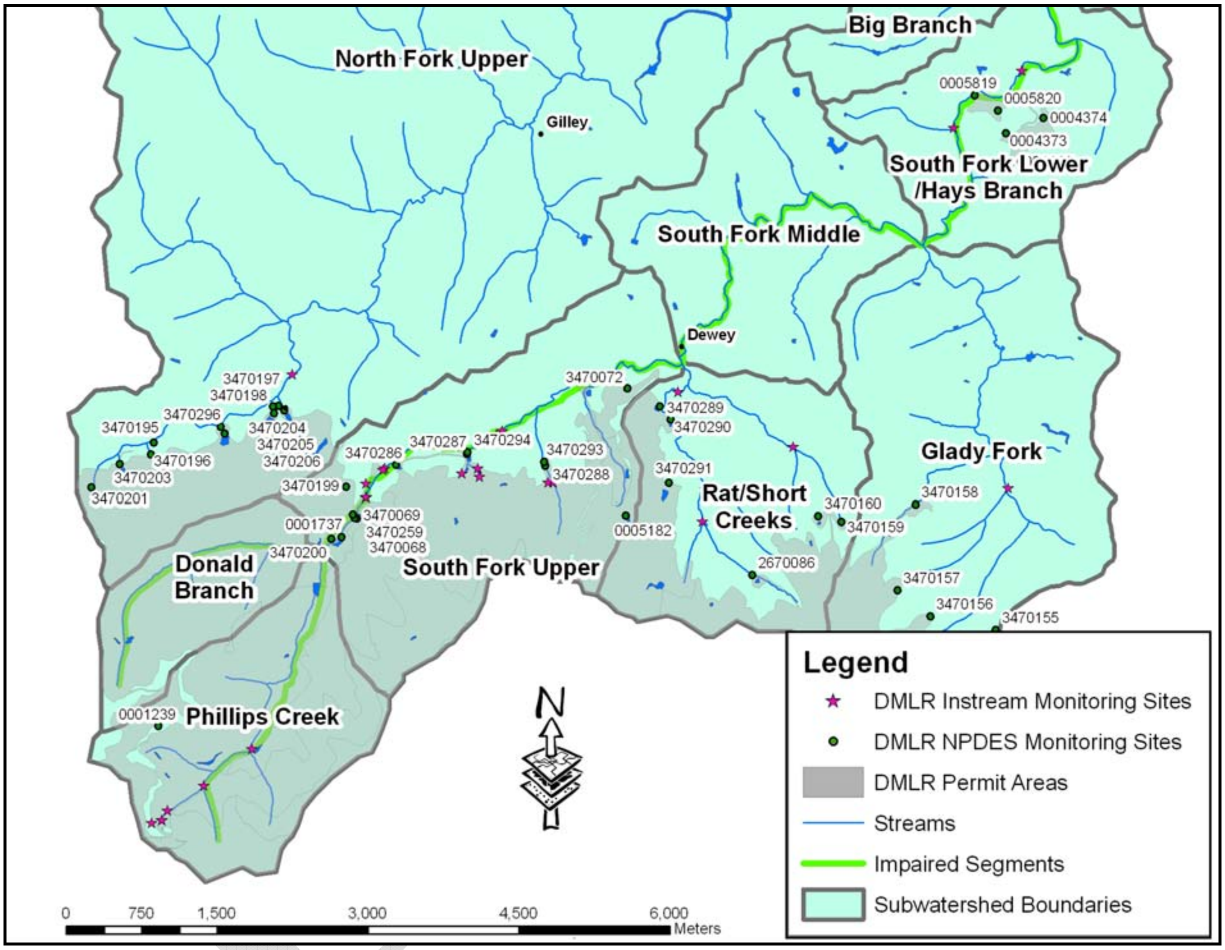

Figure 2.21. DMLR NPDES and In-stream Monitoring Points in NF and SF Pound River

Table 2.11. North Fork Pound River – Active NPDES Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
3470195	2.47	--	7.36	0.27	0.23	5.30	--	--	--	--	--	--	1101272	North Fork Upper
3470196	17.35	--	7.59	0.15	0.27	7.38	16.50	--	--	--	--	--	1101272	North Fork Upper
3470197	10.05	7.00	7.44	0.22	0.44	5.31	16.00	--	--	--	--	--	1101272	North Fork Upper
3470198	41.50	--	7.52	0.46	1.46	6.81	16.00	--	--	--	--	--	1101272	North Fork Upper
3470201	0.28	--	7.57	0.10	0.10	7.00	--	--	--	--	--	--	1101272	North Fork Upper
3470203	50.64	--	7.48	0.28	0.69	6.35	16.00	--	--	2,400.0	6,349.2	436.0	1101272	North Fork Upper
3470204	26.61	--	7.50	0.44	1.18	10.14	--	--	--	1,980.1	1,802.7	702.1	1101272	North Fork Upper
3470205	9.46	0.38	7.47	0.39	0.47	7.00	--	--	--	1,172.2	1,011.8	442.4	1101272	North Fork Upper
3470206	16.05	0.47	7.65	0.53	0.36	7.00	--	--	--	1,703.2	1,416.7	606.7	1101272	North Fork Upper
3470296	85.24	--	7.41	0.59	0.33	373.40	--	--	--	960.4	740.9	357.6	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
3470195	290	--	73	47	47	47	--	--	--	--	--	--	1101272	North Fork Upper
3470196	280	--	283	15	15	216	2	--	--	--	--	--	1101272	North Fork Upper
3470197	294	1	272	16	17	203	1	--	--	--	--	--	1101272	North Fork Upper
3470198	292	--	293	17	17	218	2	--	--	--	--	--	1101272	North Fork Upper
3470201	279	--	6	1	1	1	--	--	--	--	--	--	1101272	North Fork Upper
3470203	292	--	291	22	22	217	2	5	--	5	5	5	1101272	North Fork Upper
3470204	580	14	580	579	580	7	--	550	7	579	579	578	1101272	North Fork Upper
3470205	589	16	588	588	588	4	--	558	22	588	588	587	1101272	North Fork Upper
3470206	586	15	586	586	586	4	--	579	26	586	586	585	1101272	North Fork Upper
3470296	575	14	575	574	574	5	--	567	20	574	574	574	1101272	North Fork Upper

1995-2005	ave.	7.50	0.47	0.60	8.82	16.14	0.00	0.00	1,452.79	1,255.75	518.43
	no.	328	226	227	75	2	414	19	428	428	428
2006	ave.	7.56	0.55	0.35	4.77	--	0.00	--	1,512.64	1,239.37	652.01
	no.	27	18	18	17	0	38	0	38	38	38

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.12. North Fork Pound River – Active In-stream Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
3420219	124.79	--	7.26	0.68	0.71	11.55	13.37	0.00	87.8	1,137.2	950.8	445.8	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit Number	Sub-watershed
3420219	141	--	141	141	141	141	141	141	141	141	141	141	1101272	North Fork Upper

1995-2005	ave.	7.25	0.65	0.72	11.27	13.38	0.00	87.4	1,142.4	963.3	444.2
	no.	132	132	132	132	132	132	132	132	132	132
2006	ave.	7.31	1.02	0.50	15.67	13.22	0.00	93.0	1,060.7	768.6	470.0
	no.	9	9	9	9	9	9	9	9	9	9

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.13. South Fork Pound River – Active NPDES Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
1239	--	--	--	--	--	--	--	--	--	--	--	--	1101432	Phillips Creek
1737	--	--	--	--	--	--	--	--	--	--	--	--	1101272	South Fork Upper
4373	--	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
4374	--	--	6.70	0.10	0.40	31.00	--	--	--	--	--	--	1101783	South Fork Lower Middle
5182	1.30	--	7.23	0.10	0.13	5.00	--	--	--	--	--	--	1101401	South Fork Upper
5819	1.04	--	6.75	--	--	6.00	--	--	--	--	--	--	1101783	South Fork Lower Middle
2670086	43.03	--	7.09	0.29	0.30	6.76	16.33	--	--	--	--	--	1100717	Rat Creek
3470068	52.07	--	7.47	0.22	0.28	6.16	16.00	--	--	--	--	--	1101272	South Fork Upper
3470069	35.10	--	7.45	0.77	0.51	7.70	16.00	--	--	--	--	--	1201187	South Fork Upper
3470072	2.20	--	7.41	0.35	0.91	4.59	--	--	--	--	--	--	1101102	South Fork Upper
3470155	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470156	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470157	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470158	28.07	--	7.79	0.35	0.24	6.65	--	--	--	--	--	--	1100717	Glady Fork
3470159	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470160	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470199	0.41	--	7.50	0.15	0.45	4.50	--	--	--	--	--	--	1101272	South Fork Upper
3470259	212.94	--	7.41	0.26	0.31	5.85	16.00	--	--	--	--	--	1101272	South Fork Upper
3470286	3.91	--	7.24	0.21	0.78	5.06	--	--	--	--	--	--	1101401	South Fork Upper
3470287	228.82	--	7.61	0.23	1.28	6.55	16.00	--	--	--	--	--	1101401	South Fork Upper
3470288	36.40	--	7.00	0.13	3.69	9.65	16.00	--	--	1,072.5	884.0	501.5	1101401	South Fork Upper
3470289	15.35	--	7.34	0.34	0.31	4.85	--	--	--	--	--	--	1101401	Rat Creek
3470290	3.53	--	7.22	0.21	0.24	5.89	--	--	--	--	--	--	1101401	Rat Creek
3470291	84.24	--	6.97	0.28	0.49	7.25	16.00	--	--	--	--	--	1101401	Rat Creek
3470293	37.16	--	6.49	1.75	4.12	3.00	--	13.90	--	1,964.4	1,838.9	791.5	1101401	South Fork Upper
3470294	231.38	--	7.59	0.30	0.69	2.28	--	--	--	1,948.6	1,704.2	669.7	1101401	South Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
1239	269	--	--	--	--	--	--	--	--	--	--	--	1101432	Phillips Creek
1737	181	--	--	--	--	--	--	--	--	--	--	--	1101272	South Fork Upper
4373	64	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
4374	73	--	1	1	1	1	--	--	--	--	--	--	1101783	South Fork Lower Middle
5182	77	--	9	3	3	3	--	--	--	--	--	--	1101401	South Fork Upper
5819	24	--	2	--	--	1	--	--	--	--	--	--	1101783	South Fork Lower Middle
2670086	296	--	296	165	165	165	3	--	--	--	--	--	1100717	Rat Creek
3470068	294	--	297	164	164	164	1	--	--	--	--	--	1101272	South Fork Upper
3470069	282	--	201	104	104	104	2	--	--	--	--	--	1201187	South Fork Upper
3470072	246	--	55	16	16	16	--	--	--	--	--	--	1101102	South Fork Upper
3470155	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470156	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470157	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470158	282	--	176	83	83	83	--	--	--	--	--	--	1100717	Glady Fork
3470159	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470160	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470199	183	--	2	2	2	2	--	--	--	--	--	--	1101272	South Fork Upper
3470259	204	--	194	118	118	118	1	--	--	--	--	--	1101272	South Fork Upper
3470286	285	--	111	54	54	54	--	--	--	--	--	--	1101401	South Fork Upper
3470287	281	--	275	17	16	213	2	--	--	--	--	--	1101401	South Fork Upper
3470288	284	--	267	20	20	208	2	5	--	4	4	4	1101401	South Fork Upper
3470289	280	--	187	73	73	73	--	--	--	--	--	--	1101401	Rat Creek
3470290	276	--	37	9	9	9	--	--	--	--	--	--	1101401	Rat Creek
3470291	286	--	286	110	110	110	2	--	--	--	--	--	1101401	Rat Creek
3470293	534	--	534	534	534	2	--	520	--	520	519	519	1101401	South Fork Upper
3470294	554	--	554	554	553	5	--	539	5	539	539	537	1101401	South Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.21	0.73	1.53	7.03	16.08	7.32	0.00	1,912.4	1,727.8	683.3
	no.	172	108	107	64	2	317	5	316	316	315
2006	ave.	7.57	0.26	0.93	5.33	--	0.00	--	2,480.8	2,274.4	1,317.3
	no.	21	12	12	10	0	38	0	38	38	38

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.14. South Fork Pound River – Active In-stream Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese (mg/L)	TSS	Temperature (°C)	Acidity	Alkalinity (mg/L)	Conductivity (µmhos/cm)	TDS (mg/L)	Sulfate	Permit Number	Sub-watershed
1544	30.33	--	--	--	--	--	--	--	--	--	--	--	1100033	Phillips Creek
4380	5,750.94	--	7.68	0.23	0.31	6.28	14.66	--	150.4	1,198.5	1,137.8	507.5	1101783	South Fork Lower Middle
4381	6,248.13	--	7.63	0.20	0.28	5.46	14.84	--	151.1	1,200.5	1,111.7	509.6	1101783	South Fork Lower Middle
5063	879.29	--	7.66	0.72	0.58	5.46	13.26	--	248.4	2,066.3	1,661.8	702.9	1201383	Phillips Creek
2620125	881.74	--	7.28	0.38	0.45	16.50	12.92	--	61.0	815.8	715.7	317.7	1100033	Phillips Creek
2620126	4,317.62	--	7.80	0.62	0.69	9.75	13.60	--	193.5	1,804.4	1,418.3	616.8	1100033	South Fork Upper
3420066	3,536.65	--	7.73	0.52	0.43	12.00	13.82	--	192.0	1,487.5	1,189.9	545.9	1101272	South Fork Upper
3420084	2,490.70	--	7.73	0.48	0.40	12.00	13.67	--	183.6	1,421.7	1,119.0	495.7	1100520	South Fork Upper
3420085	925.42	--	7.42	0.47	0.36	18.18	13.76	--	122.6	980.2	797.7	380.9	1100520	Phillips Creek
3420109	4,210.50	--	7.80	0.62	0.68	9.89	13.59	--	193.7	1,807.2	1,432.4	618.5	1100787	South Fork Upper
3420110	2,451.99	--	7.72	0.49	0.41	12.16	13.68	--	183.2	1,430.6	1,128.2	495.9	1100787	South Fork Upper
3420111	931.72	--	7.41	0.49	0.36	19.05	13.67	--	125.4	1,003.1	802.6	386.7	1100787	Phillips Creek
3420175	62.09	--	6.84	0.25	0.16	13.50	13.31	--	38.2	1,289.7	1,087.7	541.9	1100717	Rat Creek
3420176	15.20	--	6.04	0.19	0.94	10.07	12.46	8.67	25.7	611.9	481.6	247.6	1100717	Rat Creek
3420177	42.29	--	7.37	0.37	0.46	10.97	13.70	--	100.8	1,071.1	924.7	397.5	1100717	Glady Fork
3420178	140.64	--	7.37	0.53	0.51	10.06	13.27	--	93.8	1,007.6	850.7	376.0	1100717	Glady Fork
3420265	2,532.89	--	7.73	0.48	0.40	12.00	13.73	--	183.6	1,417.7	1,119.0	490.9	1101401	South Fork Upper
3420267	3,169.26	--	7.28	0.35	0.33	15.78	13.33	--	77.4	892.8	664.4	303.5	1101401	Rat Creek
3420268	14.47	--	6.81	1.85	3.40	12.78	13.14	10.60	71.2	1,905.7	1,781.1	777.3	1101401	South Fork Upper
3420269	3.15	--	6.22	9.71	5.19	18.12	12.98	38.59	27.9	1,606.1	1,389.7	595.5	1101401	South Fork Upper
3420270	11.48	--	7.16	1.19	4.19	12.27	13.50	0.33	72.0	1,792.8	1,625.7	673.5	1101401	South Fork Upper
3420271	15.58	--	7.19	0.30	4.11	11.67	13.62	0.04	71.2	1,843.4	1,631.2	689.6	1101401	South Fork Upper
3420272	24.84	--	7.54	0.30	0.42	13.87	13.66	--	174.0	1,925.0	1,660.7	647.6	1101401	South Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
1544	141	--	--	--	--	--	--	--	--	--	--	--	1100033	Phillips Creek
4380	32	--	46	46	46	46	32	32	46	46	46	46	1101783	South Fork Lower Middle
4381	32	--	46	46	46	46	32	32	46	46	46	46	1101783	South Fork Lower Middle
5063	35	--	35	35	35	35	35	35	35	35	35	35	1201383	Phillips Creek
2620125	141	--	12	12	12	12	12	12	12	12	12	12	1100033	Phillips Creek
2620126	142	--	142	142	142	142	141	142	142	142	142	141	1100033	South Fork Upper
3420066	452	--	411	410	410	410	410	410	410	411	410	407	1101272	South Fork Upper
3420084	142	--	122	122	122	122	122	122	122	122	122	121	1100520	South Fork Upper
3420085	142	--	137	137	137	137	137	137	137	137	137	136	1100520	Phillips Creek
3420109	143	--	141	141	141	140	140	141	141	141	139	140	1100787	South Fork Upper
3420110	136	--	116	116	116	116	116	116	116	116	116	115	1100787	South Fork Upper
3420111	271	--	258	258	258	257	258	257	257	258	257	255	1100787	Phillips Creek
3420175	141	--	139	139	139	139	138	139	139	139	139	138	1100717	Rat Creek
3420176	141	--	92	92	92	92	91	92	92	92	92	92	1100717	Rat Creek
3420177	141	--	105	105	105	105	105	105	105	105	105	105	1100717	Glady Fork
3420178	141	--	140	140	140	140	140	140	140	140	140	139	1100717	Glady Fork
3420265	142	--	122	122	122	122	121	122	122	122	122	121	1101401	South Fork Upper
3420267	141	--	132	132	132	131	132	132	131	132	132	131	1101401	Rat Creek
3420268	141	--	139	139	139	139	138	139	139	139	139	139	1101401	South Fork Upper
3420269	141	--	59	59	59	59	59	59	59	59	59	59	1101401	South Fork Upper
3420270	218	--	216	216	216	216	216	216	216	216	216	215	1101401	South Fork Upper
3420271	217	--	216	216	216	216	216	216	216	216	216	215	1101401	South Fork Upper
3420272	217	--	217	217	217	217	217	217	217	217	217	216	1101401	South Fork Upper

Average by Sub-watershed

Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Sub-watershed
744.2		7.4	0.5	0.4	17.6	13.6		132.5	1,075.1	866.9	408.3	Phillips Creek
1,852.9		7.5	0.9	1.7	12.1	13.6		147.3	1,682.1	1,415.0	607.9	South Fork Upper
1,082.2		6.8	0.3	0.4	13.5	13.1		49.2	973.6	780.1	380.4	Rat Creek
91.5		7.4	0.5	0.5	10.4	13.5		96.8	1,034.8	882.4	385.2	Glady Fork
5,999.5		7.7	0.2	0.3	5.9	14.8		150.8	1,199.5	1,124.7	508.5	South Fork Lower Middle

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.37	0.74	1.18	13.12	13.58	1.62	126.6	1,413.6	1,177.6	504.2
	no.	129	129	129	128	127	127	128	129	128	128
2006	ave.	7.58	0.61	1.53	7.38	13.29	0.24	174.2	1,892.3	1,676.2	940.2
	no.	10	10	10	10	10	10	10	10	10	10

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

- Comparisons of individual sample measurements between the main stem and tributary DMLR in-stream monitoring stations are shown in Figure 2.22 and Figure 2.23 for pH; in Figure 2.24 and Figure 2.25 for TSS; and in Figure 2.26 and Figure 2.27 for sulfate.
- Note that the pH concentrations are lower in the tributaries and become more moderate in the main stem; the TSS and sulfate concentrations are higher in the tributaries and become diluted as they enter the main stem of South Fork Pound River.

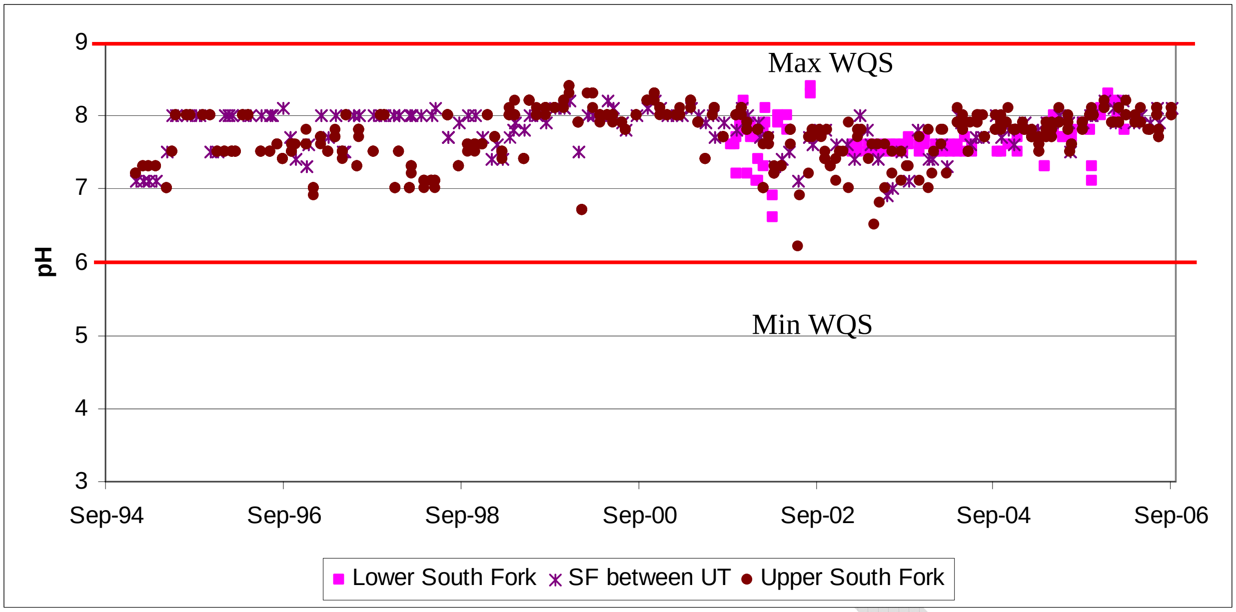

Figure 2.22. South Fork Pound River – Main Stem Stations – Active DMLR In-stream pH Data

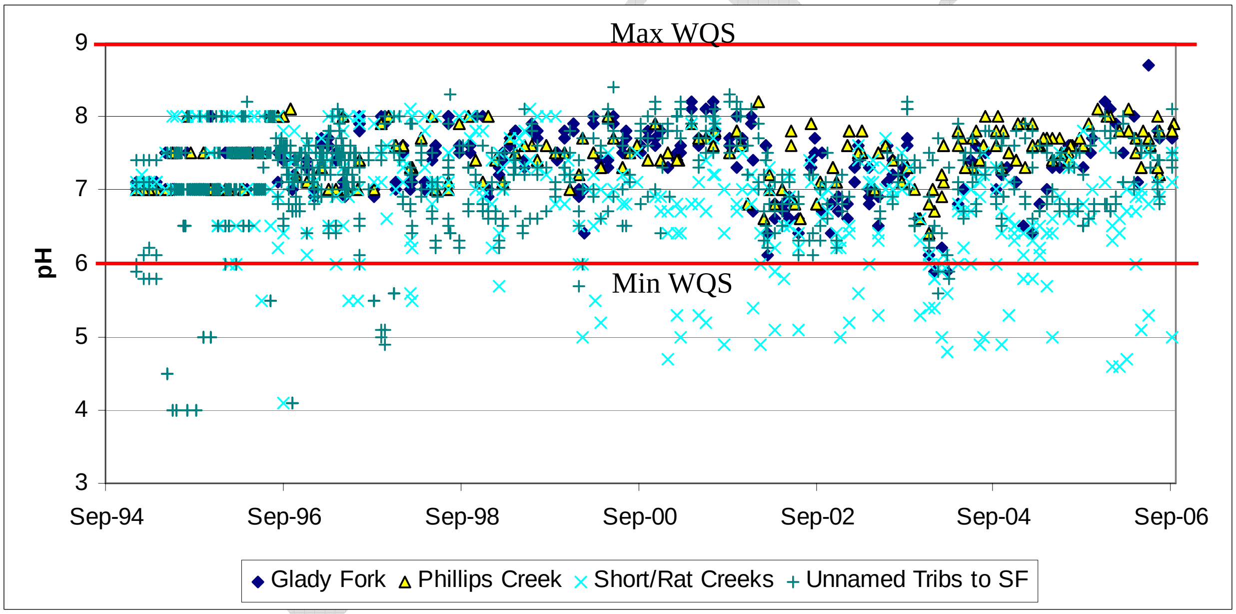

Figure 2.23. South Fork Pound River – Tributary Stations – Active DMLR In-stream pH Data

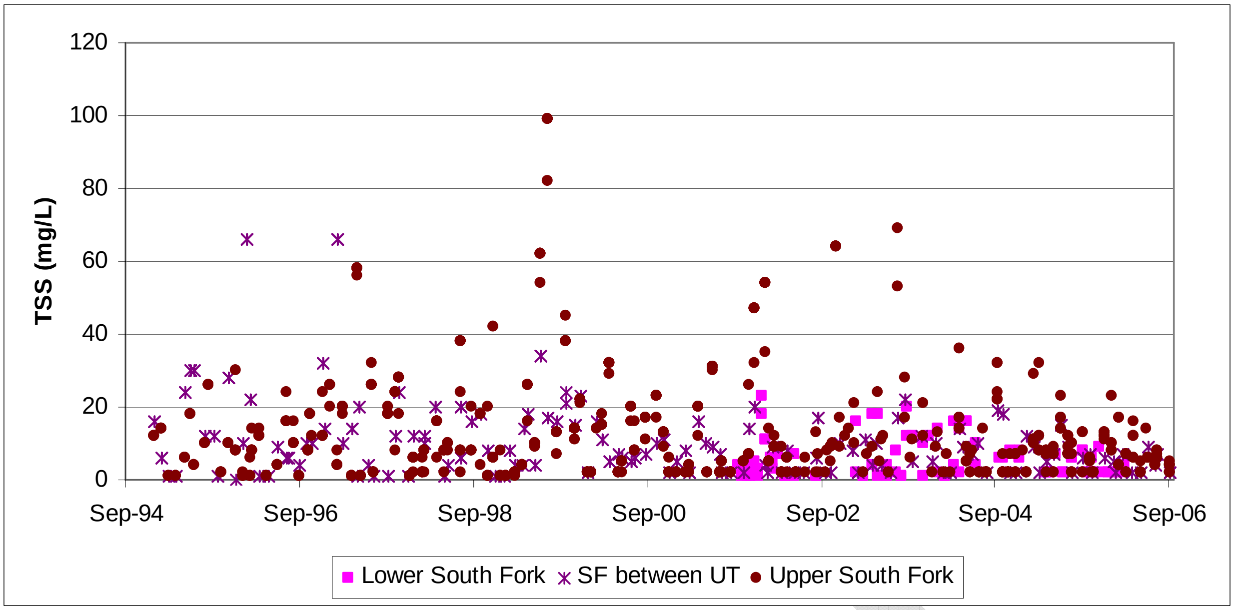

Figure 2.24. South Fork Pound River – Main Stem Stations – Active DMLR In-stream TSS Data

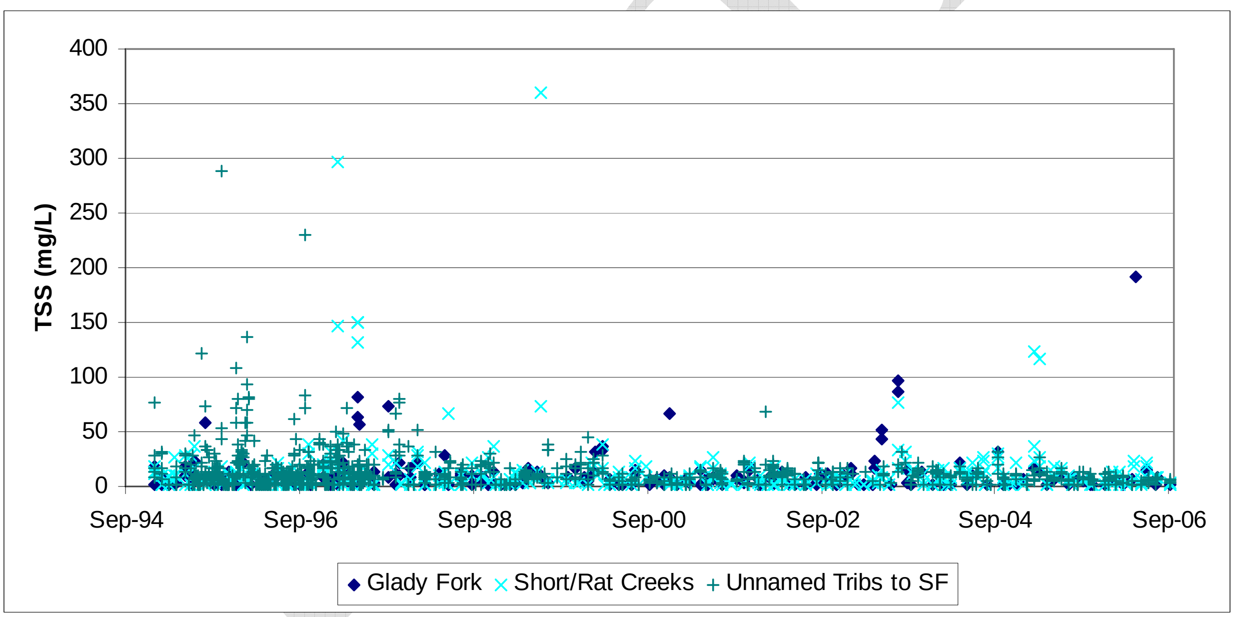

Figure 2.25. South Fork Pound River – Tributary Stations – Active DMLR In-stream TSS Data

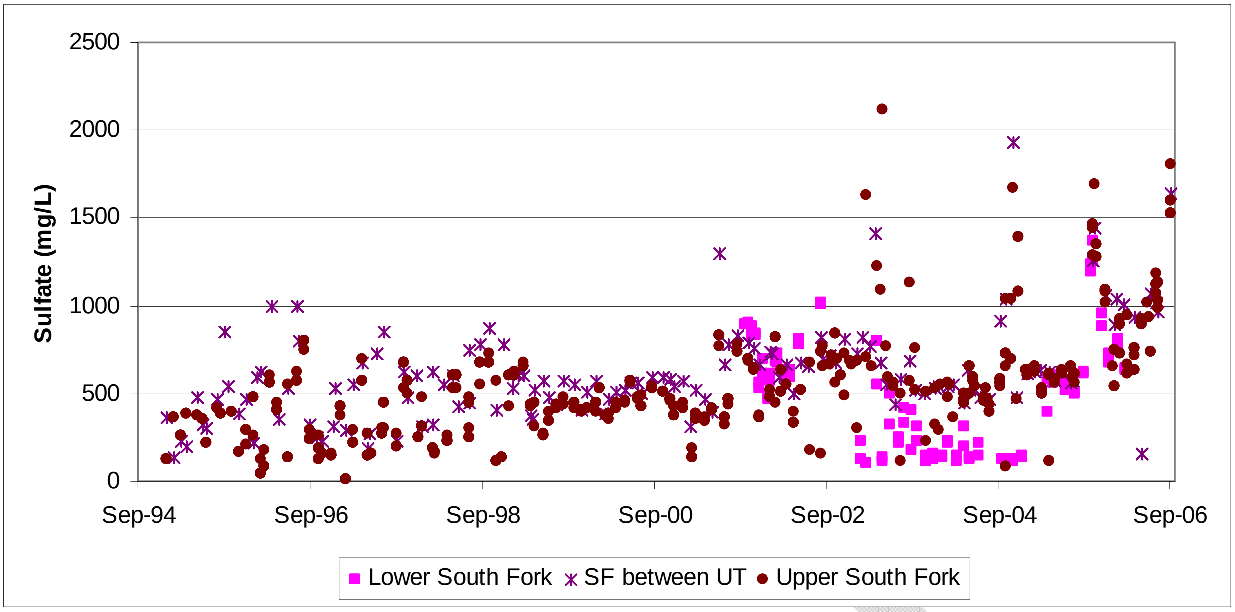

Figure 2.26. South Fork Pound River – Main Stem Stations – Active DMLR In-stream Sulfate Data

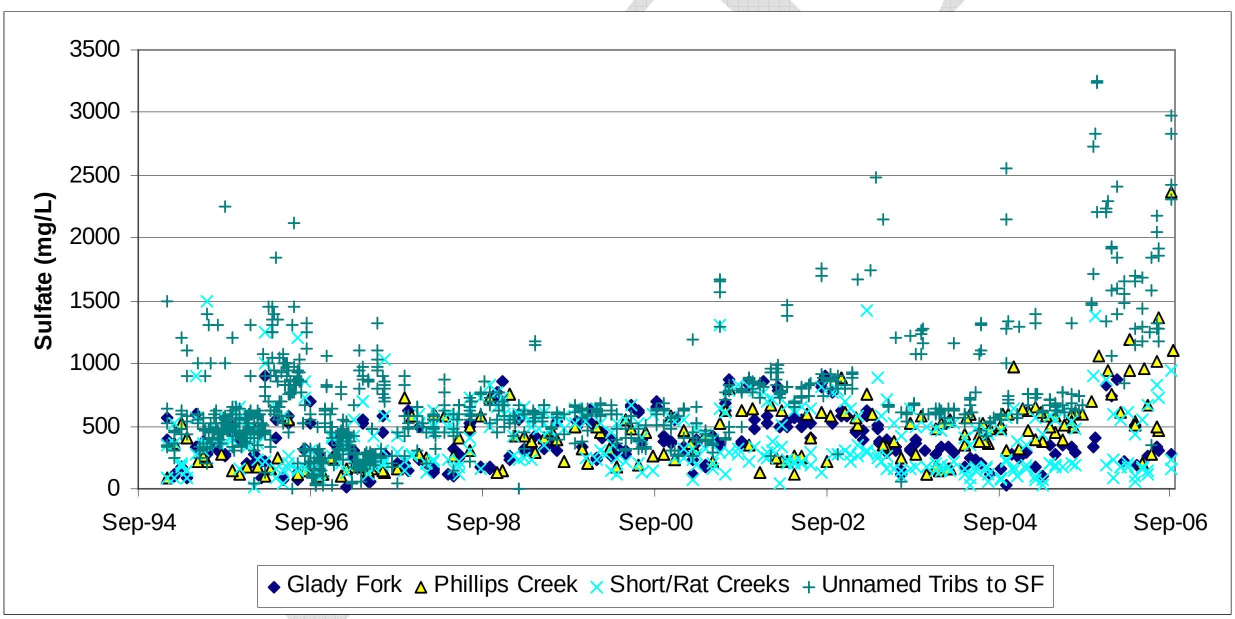

Figure 2.27. South Fork Pound River – Tributary Stations – Active DMLR In-stream Sulfate Data

- DMLR groundwater monitoring locations are shown in Figure 2.28.
- Average concentrations of monitored parameters are shown by monitoring point identification number (MPID) for the North Fork and South Fork Pound River sites in Table 2.15 and Table 2.16, respectively.

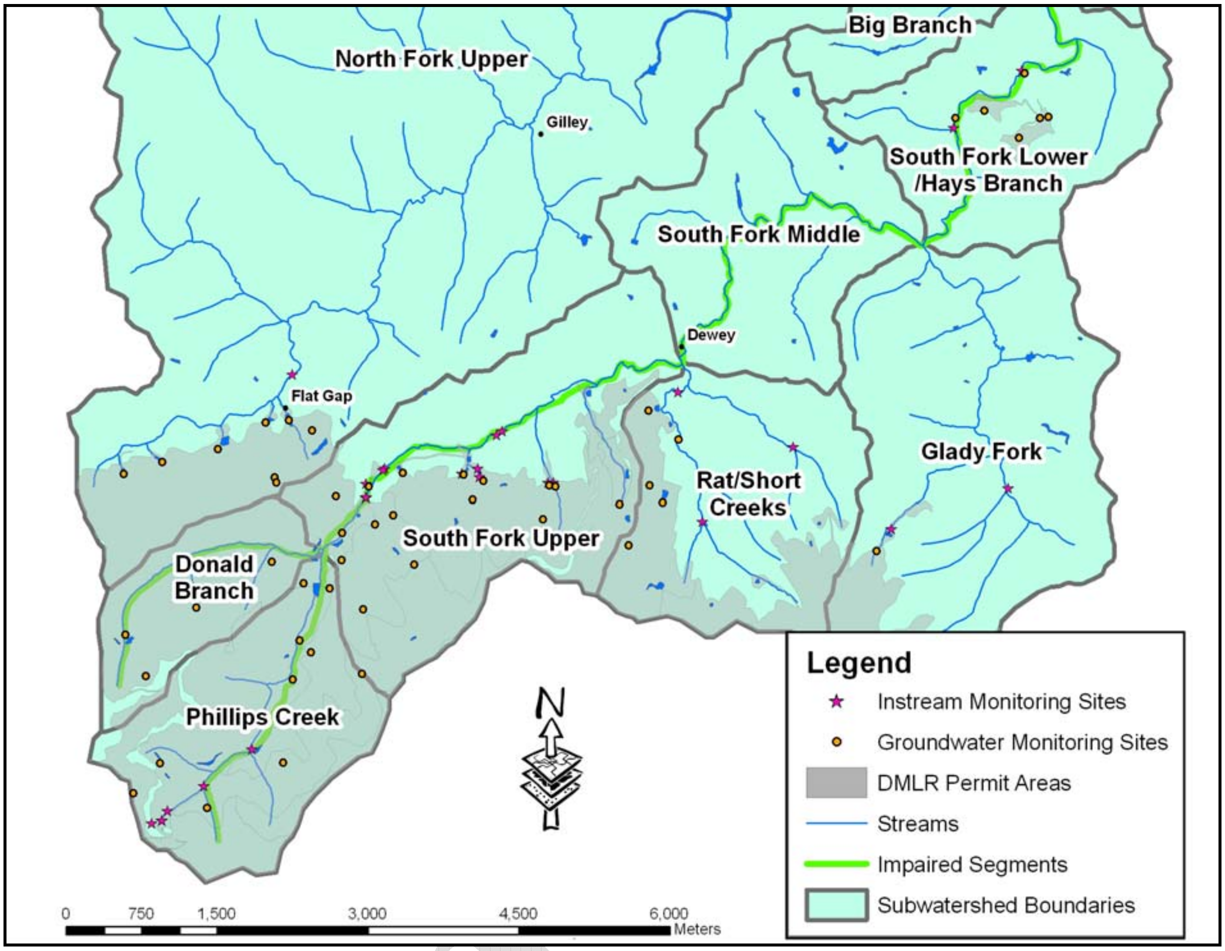

Figure 2.28. DMME-DMLR Active Groundwater Monitoring Sites

Table 2.15. North Fork Pound River – Active Groundwater Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese (mg/L)	TSS	Temperature (°C)	Acidity	Alkalinity (mg/L)	Conductivity (µmhos/cm)	TDS	Sulfate (mg/L)	Permit Number	Sub-watershed
3450208	--	--	--	--	--	--	--	--	--	--	--	--	1101272	North Fork Upper
3450212	1.21	--	7.42	0.28	0.16	5.00	12.34	--	137.1	1,027.3	895.9	453.1	1101272	North Fork Upper
3450213	6.91	--	7.66	1.07	0.35	10.52	13.51	--	146.3	1,675.2	1,424.4	575.9	1101272	North Fork Upper
3450214	4.80	--	7.45	0.33	0.20	6.77	13.42	--	128.3	1,124.1	937.8	393.9	1101272	North Fork Upper
3450215	10.67	--	7.57	0.50	1.69	10.19	13.71	--	113.0	1,999.4	1,879.7	749.3	1101272	North Fork Upper
3450297	9.75	--	7.58	0.52	0.36	7.98	13.70	--	151.2	1,159.3	1,086.3	466.7	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit Number	Sub-watershed
3450208	84	17	--	--	--	--	--	--	--	--	--	--	1101272	North Fork Upper
3450212	271	--	73	13	13	13	73	13	13	73	13	13	1101272	North Fork Upper
3450213	274	--	274	48	48	48	273	48	48	274	48	48	1101272	North Fork Upper
3450214	272	--	258	44	44	44	258	44	44	258	44	44	1101272	North Fork Upper
3450215	273	--	273	47	47	47	273	47	47	273	47	47	1101272	North Fork Upper
3450297	275	--	272	46	46	46	272	46	46	272	46	46	1101272	North Fork Upper

1995-2005	ave.	7.56	0.60	0.64	9.10	13.68	0.00	133.3	1,462.4	1,312.2	518.8
	no.	207	36	36	36	207	36	36	207	36	36
2006	ave.	7.57	0.55	0.44	4.75	11.90	0.00	149.0	1,492.3	1,301.5	759.6
	no.	23	4	4	4	23	4	4	23	4	4

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.16. South Fork Pound River – Active Groundwater Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese (mg/L)	TSS	Temperature (°C)	Acidity	Alkalinity (mg/L)	Conductivity (µmhos/cm)	TDS	Sulfate (mg/L)	Permit Number	Sub-watershed
89	4.12	3.00	7.30	0.67	0.72	16.62	13.10	--	131.4	1,281.3	890.9	422.0	1101401	Rat Creek
936	0.88	--	6.76	0.45	5.54	10.25	12.49	8.50	103.5	1,212.9	1,250.3	509.4	1101401	South Fork Upper
1397	2.02	--	7.72	0.24	0.10	5.00	12.18	--	111.4	1,567.1	1,249.0	388.8	1100520	South Fork Upper
1738	24.31	--	7.43	0.10	0.10	8.00	8.50	--	99.0	1,047.5	714.5	327.0	1101272	South Fork Upper
1770	--	--	--	--	--	--	--	--	--	--	--	--	1201187	South Fork Upper
4375	25.02	50.00	7.23	0.73	0.16	23.91	14.93	--	58.0	596.0	444.5	234.0	1101783	South Fork Lower Middle
4376	0.63	--	7.60	--	--	--	19.00	--	--	650.0	--	--	1101783	South Fork Lower Middle
4377	--	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
5061	42.56	--	7.51	0.15	0.03	4.13	10.34	--	202.3	776.4	500.6	210.6	1201383	Phillips Creek
5707	--	88.27	7.24	0.60	0.70	6.00	13.47	--	258.3	1,312.0	1,176.7	430.3	1600876	Phillips Creek
3440273	14.38	5.76	6.83	40.32	2.35	125.35	14.07	--	214.5	1,851.7	1,612.2	669.6	1101272	South Fork Upper
3440274	285.00	--	6.73	0.28	0.07	5.68	16.43	--	86.6	365.4	192.8	36.6	1101401	Rat Creek
3441025	50.00	--	7.10	--	--	--	13.33	--	--	2,000.0	--	--	1100520	Phillips Creek
3450173	9.49	--	7.53	0.44	0.33	11.94	13.40	--	111.1	1,163.5	970.5	403.7	1100717	Glady Fork
3450280	2.03	--	6.89	1.51	4.15	9.05	13.99	14.16	96.5	968.9	887.6	548.4	1101401	South Fork Upper
3450281	13.05	15.00	7.16	0.40	4.93	12.22	13.50	--	80.6	1,903.8	1,928.4	691.6	1101401	South Fork Upper
3450282	20.36	--	7.46	0.29	0.33	7.37	13.52	--	190.3	2,075.9	1,867.1	687.4	1101401	South Fork Upper
3450283	13.12	--	7.04	0.50	2.22	14.47	13.77	3.33	69.1	1,619.2	1,760.8	623.8	1101401	South Fork Upper
3450284	1.83	20.00	6.83	1.28	3.77	31.25	13.09	--	50.9	1,427.7	1,422.1	493.6	1101401	South Fork Upper
3450285	18.90	15.00	4.71	2.18	13.40	12.51	13.55	145.38	5.4	2,903.9	2,663.3	920.3	1101401	Rat Creek
3450316	--	14.37	4.41	0.54	1.73	18.73	12.71	18.91	21.5	299.9	218.3	104.3	1101432	Phillips Creek
3451027	--	--	--	--	--	--	--	--	--	--	--	--	1100520	Phillips Creek
3451032	38.68	--	7.49	0.46	0.38	7.40	13.97	--	151.5	1,196.1	1,132.8	475.2	1100520	South Fork Upper
3451981	--	--	--	--	--	--	--	--	--	--	--	--	1100787	South Fork Upper

Number of Samples During Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
89	264	1	203	34	34	34	203	34	34	203	34	34	1101401	Rat Creek
936	264	--	41	8	8	8	41	8	8	41	8	8	1101401	South Fork Upper
1397	278	--	28	8	8	8	28	8	8	28	8	8	1100520	South Fork Upper
1738	181	--	8	2	2	2	8	2	2	8	2	2	1101272	South Fork Upper
1770	173	--	--	--	--	--	--	--	--	--	--	--	1201187	South Fork Upper
4375	63	1	58	22	22	22	45	9	22	58	22	22	1101783	South Fork Lower Middle
4376	40	13	1	--	--	--	1	--	--	1	--	--	1101783	South Fork Lower Middle
4377	40	13	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
5061	39	--	39	8	8	8	38	8	8	39	8	8	1201383	Phillips Creek
5707	--	45	45	7	7	7	45	7	7	45	7	7	1600876	Phillips Creek
3440273	330	903	972	156	156	156	962	156	156	972	156	156	1101272	South Fork Upper
3440274	2	1	280	47	47	47	280	47	47	280	47	46	1101401	Rat Creek
3441025	3	--	3	--	--	--	3	--	--	3	--	--	1100520	Phillips Creek
3450173	283	--	209	35	35	35	209	35	35	209	35	35	1100717	Glady Fork
3450280	273	--	107	19	19	19	107	19	19	107	19	19	1101401	South Fork Upper
3450281	268	1	264	45	45	45	263	45	45	264	45	45	1101401	South Fork Upper
3450282	252	--	250	43	43	43	250	43	43	250	43	43	1101401	South Fork Upper
3450283	274	--	270	45	45	45	268	45	45	270	45	45	1101401	South Fork Upper
3450284	265	3	102	16	16	16	102	16	16	102	16	16	1101401	South Fork Upper
3450285	281	1	281	47	47	47	280	47	47	281	47	47	1101401	Rat Creek
3450316	109	240	57	11	11	11	55	11	11	57	11	11	1101432	Phillips Creek
3451027	86	67	--	--	--	--	--	--	--	--	--	--	1100520	Phillips Creek
3451032	275	--	274	47	47	47	273	47	47	274	47	47	1100520	South Fork Upper
3451981	264	--	--	--	--	--	--	--	--	--	--	--	1100787	South Fork Upper

Average by Sub-watershed

Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Sub-watershed
43.1		6.2	0.4	0.9	10.8	12.3	8.0	140.9	780.7	563.2	224.8	Phillips Creek
12.7		7.1	16.5	2.3	57.1	13.8	6.8	154.4	1,700.2	1,573.5	621.3	South Fork Upper
12.7		6.1	1.1	5.1	11.1	14.5	145.4	68.7	1,542.5	1,285.4	466.8	Rat Creek
9.5		7.5	0.4	0.3	11.9	13.4		111.1	1,163.5	970.5	403.7	Glady Fork
15.5		7.2	0.7	0.2	23.9	15.0		58.0	596.9	444.5	234.0	South Fork Lower Middle

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	6.84	11.33	2.54	43.43	13.94	13.03	125.3	1,549.1	1,362.0	510.1
	no.	152	29	29	29	150	29	29	152	29	29
2006	ave.	6.95	7.51	3.98	20.73	13.15	10.71	173.2	1,877.0	1,704.7	905.2
	no.	23	4	4	4	23	4	4	23	4	4

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

- Although average pH values at all DMLR groundwater monitoring stations and all individual in-stream pH measurements were within water quality standard limits, individual groundwater sample pH values were frequently exceeded the lower limit in Phillips Creek and the upper reaches of South Fork Pound River, as shown in Figure 2.29.

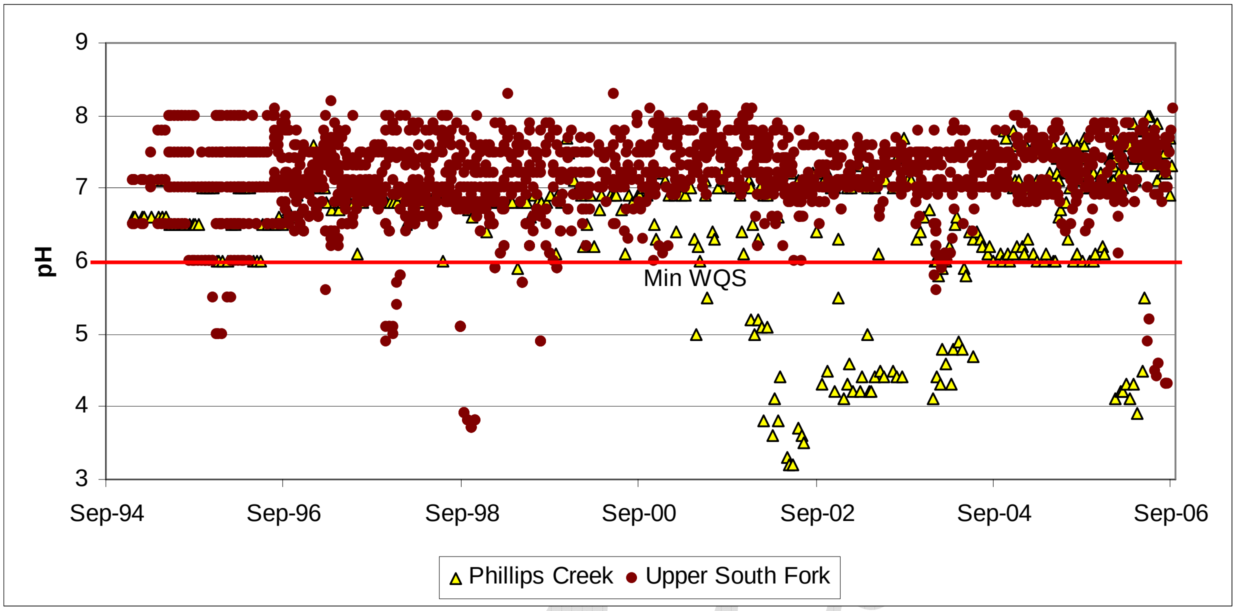

Figure 2.29. Phillips Creek and Upper South Fork Pound River – Active DMLR Groundwater pH Data

2.7. DMME – DGO Permit Summary

- A summary of the current active well and plugged release well permits in the area are shown in Table 2.17. Currently there are 40 active wells in the watershed with an additional 16 wells permitted that have not yet been constructed. These gas and oil well locations are shown in Figure 2.30.
- Because of the recent flurry of activity surrounding the energy-producing industry, word has it that up to 600 new gas and oil wells may be slated for Wise County in the coming years. Reclaimed areas not in other uses might be prime target areas for these applications.
- A summary of all DMME permits in the area encompassing the impaired segments and their related drainage are shown by sub-watershed in Table 2.18. The sub-watershed location map was shown previously in Figure 2.1.

Table 2.17. DMME Division of Gas and Oil (DGO) Well Permit Summary

Permit No.	Operation ID	Company Name	County	USGS Quad	Sub-watershed	Operation Description	Permit Status Description
				Active Wells			
WS-0296	VP133805	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0426	V-3140	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0487	V-3400	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0571	V-4200	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0573	V-4199	Equitable Production Company	WISE	FLAT GAP	BEAR BRANCH	Gas	Producing
WS-0574	V-4286	Equitable Production Company	WISE	FLAT GAP	BEAR CREEK	Gas	Producing
WS-0575	V-4320	Equitable Production Company	WISE	FLAT GAP	BAD BRANCH	Gas	Producing
WS-0576	V-4288	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0578	V-4319	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0579	V-4198	Equitable Production Company	WISE	FLAT GAP	BEAR FORK	Gas	Producing
WS-0580	V-4318	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0583	VP-4287 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0585	V-4285	Equitable Production Company	WISE	FLAT GAP	BEAR FORK	Gas	Producing
WS-0491	V-3607 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0506	V-3686 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0524	V-3831 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0536	V-3833 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0539	V-3801 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0540	V-3803 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0541	V-3802 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0554	V-3832 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	BEAR CREEK	Gas/Pipeline	Producing
WS-0588	V-4358 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0589	V-4572 W/Pipeline	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas/Pipeline	Producing
WS-0591	V-4571 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas/Pipeline	Producing
WS-0592	V-4289 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0636	V-505027 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	CUMBERLAND RIVER	Gas/Pipeline	Producing
WS-0638	V-502795 W/Pipeline	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0502	V-3665	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Shut In
WS-0465	V-3199	Equitable Production Company	WISE	FLAT GAP	PHILLIPS CREEK	Gas	Producing
WS-0489	V-3609	Equitable Production Company	WISE	FLAT GAP	PHILLIPS CREEK	Gas	Producing
WS-0494	VAD-2839	Equitable Production Company	WISE	FLAT GAP	GLADY FORK	Gas/CB Dual Completion	Producing
				Plugged Released Wells			
WS-0516	VC-3136 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Coalbed/Pipeline	Plugged/Abandoned
WS-0526	VC-3813 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Coalbed/Pipeline	Plugged/Abandoned
WS-0043	10001	Wise Oil & Gas	WISE	FLAT GAP	North Fork Upper	Gas	Plugging/Plugged/Abandoned
WS-0001	VP133501	Equitable Production Company	WISE	FLAT GAP	Phillips Creek	Gas	Released
WS-0459	V-3199	EQUITABLE PRODUCTION COMPANY	WISE	FLAT GAP	South Fork Upper	Gas	Plugging/Plugged/Abandoned
WS-0007	163	Clinchfield Coal Co	WISE	POUND	Glady Fork	Gas	Plugging/Plugged/Abandoned

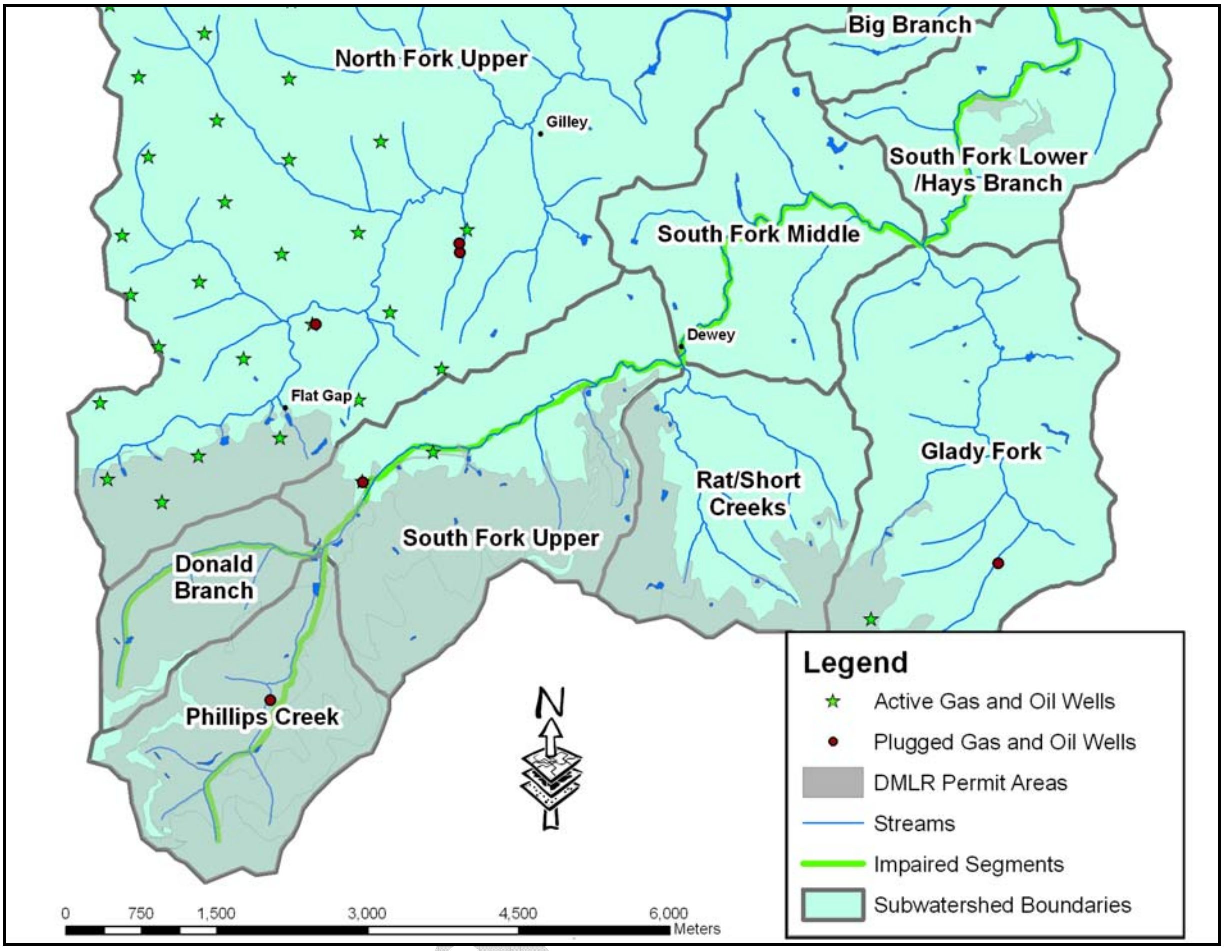

Figure 2.30. DMME DGO Gas Well Locations

Table 2.18. Summary of DMME Permits and Monitoring Sites in NF and SF Pound River

Type of DMME Permits/Monitoring	NF Pound River Sub-watersheds					SF Pound River Sub-watersheds								Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	
DGO Active Wells					28				1		2			31
DGO Pending Wells														0
DGO Plugged Release Wells					3				1		1		1	6
DMLR NPDES Permits					10		5		4	6	13		1	39
DMLR Instream Monitoring Sites					1		2		2	3	11		5	24
DMLR Groundwater Monitoring Sites					6		3		1	4	20	1	5	40

2.8. US Army Corps of Engineers (USACE) Daily Flow Measurements

- The impaired segment on the North Fork Pound River begins at the outfall from the North Fork Pound Lake Dam and extends downstream to its confluence with the South Fork Pound River.
- The North Fork Pound Lake is a public water supply and is operated by the U.S. Army Corps of Engineers. As such, the water level in the lake is drawn down by approximately 7 feet between October and December each year in order to provide extra storage capacity for winter and spring storm runoff to prevent downstream flooding, as shown in Figure 2.31. The influence of this activity on the biological community is unknown. A new DEQ monitoring station has been added earlier this year just past the mixing zone form the dam's outfall to assist in this diagnosis.

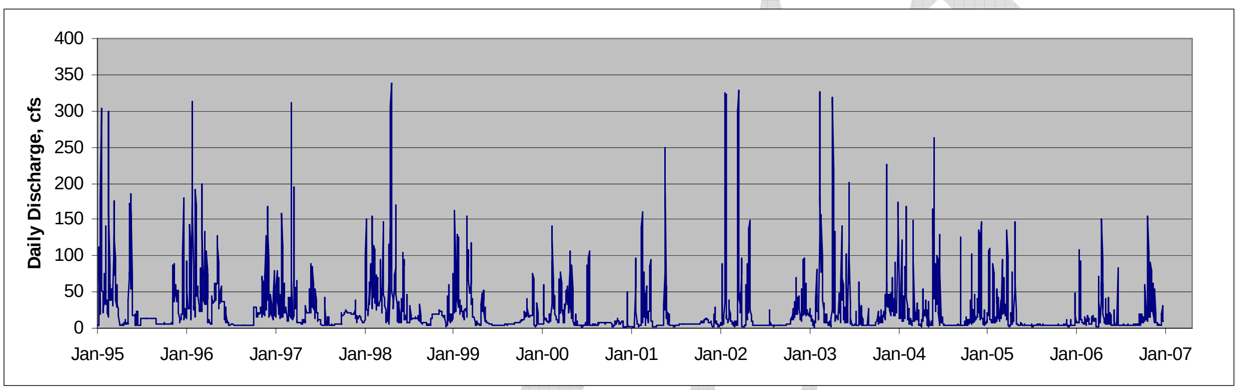

Figure 2.31. USACE Daily Flow at North Fork Pound Lake Outflow

2.9. 305(b)/303(d) Combined Report – Monitored Exceedences

- In all four biennial reports between 1998 and 2004 (VADEQ, 1998, 2000, 2002, 2004b), no standards exceedences of temperature, pH, or DO were reported for any of the North Fork and South Fork Pound River stations, as shown in Table 2.19 below.
- One violation in the South Fork Pound River was noted for Nickel in bottom sediments in the 2004 assessment, based on a sample in October 2001. A second violation was also noted in a sample taken at the same site in August 2006.

Table 2.19. 305(b) Water Quality Standard – Monitored Exceedences

				CONVENTIONAL WATER COLUMN MONITORING DATA #Violations/# Samples/Status			OTHER WATER COLUMN DATA #Violations/# Samples/Status				SEDIMENT #Violations/Status		BENTHIC		
Year	WBID	Monitoring Station	Type	Temperature	Dissolved Oxygen	pH	Fecal Coliform	Total Phosphorus	Chlorophyll A	Organics	Metals	Organics	Bio Mon	Station Type	Comments
1998	**S-Q13R**	**6APNK000.08**	B	/	/	/	/	/	/				**MI**	net	
1998	**S-Q13R**	**6APNS000.40**	B	/	/	/	/	/	/				**VI**	net	
2000	**S-Q13R**	**6APNK000.08**	B	/	/	/	/	/	/				**MI**	net	
2000	**S-Q13R**	**6APNS000.40**	B	/	/	/	/	/	/				**VI**	net	
2002	**S-Q13R**	**6APNK000.08**	B	0 / 4 S	0 / 4 S	0 / 4 S	/	/	/				**MI**	net	
2002	**S-Q13R**	**6APNS000.40**	B	0 / 4 S	0 / 4 S	0 / 4 S	/	/	/				**MI**	net	
2002	S-Q13R	6APNS004.98	B	0 / 0 W	0 / 0 W	0 / 0 W	/	/	/				T	net	additional monitoring needed
2002	**S-Q13R**	**6APNS008.73**	B	0 / 0 W	0 / 0 W	0 / 0 W	/	/	/				**VI**	net	
2004	**S-Q13R**	**6APLL000.17**	B										**NI**		
2004	**S-Q13R**	**6APNK000.08**	A,B	0 / 2 S	0 / 2 S	0 / 2 S							**MI**		
2004	**S-Q13R**	**6APNS000.40**	B	0 / 2 S	0 / 2 S	0 / 2 S							**MI**		
2004	S-Q13R	6APNS003.94	FPM	0 / 1 W	0 / 1 W	0 / 1 W	1 / 1 W				1 O		SI		Ni in sed 52.00
2004	**S-Q13R**	**6APNS004.98**	B										**MI**		
2004	**S-Q13R**	**6APNS008.73**	B										**VI**		
2006		**None Listed**													
		Bold/Shaded = Impaired Waters													
		Pink = Threatened Waters / Observed Effects													

2.10. Ancillary Data

- The Virginia Department of Conservation and Recreation performs a biennial assessment of NPS pollutant loads for each of the state's 493 14-digit hydrologic units (VADCR, 2004). All of the North Fork and South Fork Pound River impaired segments are within the Q13 hydrologic unit.
- This NPS pollutant potential assessment ranks urban and forestry land uses in this hydrologic unit with high potential for sediment, N, and P loading. In this classification, urban land uses include mining.

Table 2.20. VADCR Watershed NPS Pollutant Ratings – Q13

Watershed-ID	Year	AGR_N	AGR_P	AGR_S	URB_N	URB_P	URB_S	FOR_N	FOR_P	FOR_S	TOT_N	TOT_P	TOT_S	RIMP	EIMP	LIMP	SWP	IBI
Q13	2006	L	L	L	H	H	H	H	H	H	L	M	M	L	N	L	D	D
Q13	2004	L	L	L	M	H	H	H	H	H	L	M	L	L	N	L	D	D
Q13	2002	L	L	L	M	H	H	H	H	H	L	M	L	L	N	L	D	D
Q13	2000		L			L			L		L	--	--	M	N	--	--	--

Header Codes
AGR - agriculture
URB - urban
FOR - forestry
N - nitrogen
P - phosphorus
S - sediment
RIMP - Riverine Impairments
EIMP - Estuarine Impairments
LIMP - Lacustrine Impairments

Nutrient & Impairment Rank Codes
H - High
M - Medium
L - Low
N - Not Applicable

SWP - Source Water Protection Codes
A - Very High
B - High
C - Moderate
D - Low
E - None

IBI - miniMIBI Codes
A: 16-24/5
B: 16-24/1-3
C: 13-15
D: 1-12
E: Insufficient Data

3.0 Analysis of Candidate Stressors for North Fork Pound River

The purpose of the stressor analysis is to look for a stressor that was present in the April 1993 – March 1995 period, which caused North Fork Pound River's initial 1996 listing on the impaired waters list. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat. Virginia SCI ratings suggest that the benthic community has been alternately slightly stressed and non-impaired at different times during the period from 1990 to 2006.

A list of candidate stressors was developed for North Fork Pound River and evaluated to determine the pollutant(s) responsible for the benthic impairment. The potential stressor checklist in Appendix A1 was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized in Appendix B1 as the basis for each potential stressor. Depending on the strength of available evidence, the potential stressors were either "eliminated", considered as "possible" stressors, or recommended as the "most probable" stressor(s). Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS/conductivity/sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

3.1. Eliminated Stressors

3.1.1. Ammonia

High values of ammonia are toxic to many fish species and may impact the benthic community as well. All the values recorded at PNK000.08 were at or below the minimum detection limit (MDL) of 0.04 mg/L. No fish kills have been reported in this watershed and nothing in the ambient monitored data indicates ammonia as a stressor, therefore it is eliminated from further consideration as a stressor for North Fork Pound River.

3.1.2. Nutrients

Excessive nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macroinvertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. The majority of DEQ-monitored dissolved phosphorus concentrations have been at or below their minimum analytical detection limit at all stations and, therefore, the segment has never exceeded DEQ's "threatened waters" threshold. The average total nitrogen concentrations are among the lowest of all DEQ ambient stations.

While the benthic community in the North Fork Pound River has been occasionally dominated by Chironomidae or Hydropsychidae or Simuliidae – organisms associated with excessive nutrients, it has also been frequently dominated by low pollution tolerant (2-4) organisms. Low riparian vegetation scores have been recorded over time in the habitat metrics, which could promote increased nutrient transport through surface runoff. However, the very low monitored in-stream nutrient concentrations argue against this source. Therefore, nutrients have been eliminated as a possible stressor.

3.1.3. pH

Benthic macroinvertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macroinvertebrates. Treated wastewater and urban runoff can potentially alter in-stream levels of pH. No exceedence of the minimum or maximum pH standard occurred in at either of the stations on the impaired segment. Therefore, pH would be an unlikely source of stress and it was eliminated from further consideration as a stressor.

3.1.4. TDS/Conductivity/Sulfates

Total dissolved solids (TDS) consist primarily of dissolved salts (ionized substances) plus dissolved metals, minerals and organic matter. Electrical conductivity is a measure of the ability of a solution to carry a current based on the concentration of ionized substances dissolved in the water, and so has a direct correlation with TDS. Since each type of ion has a different ability to conduct electricity, however, conductivity will not be directly equivalent to TDS, as conductivity strength will depend on the composition of ions in the TDS sample. The major components of TDS are calcium, magnesium, potassium, sodium, bicarbonate, chlorides, and sulfates. Since sulfates are a component of TDS, and since conductivity is closely related to TDS, these three parameters are considered together as a possible stressor. Sources of TDS include mining operations, raw sewage, road salts, irrigation water, and improper discharge or treatment of water softening compounds. Virginia has no surface water quality standards for any of these, though it does have taste and odor criteria for public drinking water supplies of 500 mg/L for TDS and 250 mg/L for sulfates. These values along with a conductivity concentration of 500 µmhos/cm have been used as screening values to denote elevated concentrations.

The average TDS, conductivity, and sulfate concentrations in the headwaters of North Fork Pound River watershed monitored by DMLR were found to be greater than their respective screening values for the samples analyzed from NPDES ponds, in-stream, and groundwater monitoring. However, recent DEQ monitoring in 2006 and 2007 along the impaired segment has recorded conductivity and sulfate concentrations below the screening values and between one and two orders of magnitude smaller than in the mined headwaters. Therefore, this suite of parameters does not appear to be a stressor in this portion of the watershed and has been eliminated as a possible stressor.

3.1.5. Toxics

Although several biological samples in spring 1994 and spring 1998 have reported low numbers of total organisms, there have been no reports of fish kills or exceedences of any known aquatic life or human health criteria. While mining has occurred in the headwaters of North Fork Pound River, the relative percentage of mined area is minor and the distance between this potential source and the outlet is fairly large and separated by the North Fork Pound Lake. Hence toxics are eliminated as a stressor to benthic community in the impaired segment of the North Fork Pound River.

3.2. Possible Stressors

3.2.1. Hydrologic Modifications

Hydrologic modifications can cause shifts in the supply of water, sediment, food supply, habitat, and pollutants from one part of the watershed to another, thereby causing changes in the types of biological communities that can be supported by the changed environment. The headwaters of the North Fork Pound River watershed have been intensively mined, though they are separated by a long distance from the downstream impaired segment. The North Fork Pound Lake is a hydrologic modification that undoubtedly had an impact on the downstream community. Buildings in the outskirts of Pound are crowded into the riparian corridor along the impaired segment, and the lake discharge is controlled between October and December in order to draw down the lake and increase storage capacity for protection against spring floods. While all these modifications have undoubtedly created stress in the impaired segment, most of the re-adjustment was expected to have occurred prior to the declared impairment, though with the many unknowns and sparse data, hydrologic modifications are considered a possible stressor.

3.2.2. Organic Matter

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macroinvertebrates. Potential sources of organic matter in the impaired North Fork Pound River segment include household wastewater discharges, malfunctioning septic systems, and runoff from impervious areas. Most of the watershed is sewered, so the septic system load is expected to be minor. High values of the modified family biotic index (MFBI) metric recorded on several occasions at PNK000.08 are indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in many of the samples – Hydropsychidae and Simuliidae – typical of organic-enriched sites, and the low ratios of scrapers to filterer-collectors, indicative of abundant suspended organic matter used as a food source for the filterer-collectors. However, no problems were monitored with DO depletion, and another organic measurement – COD – was also at minimal levels. Therefore, while organic matter is considered to be a possible stressor, it is unlikely to have been a major source of stress.

3.2.3. Temperature

North Fork Pound River is classified as a Class V mountain stream with a maximum temperature standard of 21°C. The riparian vegetation in North Fork Pound River has received poor scores on some occasions and the temperature of water at the outlet of North Fork Pound River has exceeded the standard during all available summer measurements (3 samples in 2006, 2 samples in 2007). Therefore, temperature appears to be a possible stressor for fish, although its impact on the benthic community in North Fork Pound River is expected to be minimal.

3.3. Most Probable Stressor

The most probable stressor to the benthic community for this minor impairment on the North Fork Pound River is considered to be sediment, based on the following summary of available evidence.

3.3.1. Sediment

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macroinvertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, construction sites, in-stream disturbances, and lake discharge. Although most of the biological samples contained a good proportion of Haptobenthos, which requires clean substrates, sediment is supported as a stressor for this minor impairment through the poor habitat metrics related to sediment including bank stability, embeddedness, riparian vegetation, and sediment deposition. Point sources are not present in the drainage to this segment and agricultural sources are sparse. Ambient TSS concentrations are low, but no runoff samples have been analyzed for NPS sediment, which is suspected. Therefore, sediment problems appear to be related to barren areas in the watershed that are subject to soil detachment, runoff from impervious areas, and possibly from lake discharge. Barren areas include recently cleared forested areas, new construction, and poorly vegetated riparian areas along streams. Because the impairment is relatively minor, and the sediment-related habitat metrics have been low, sediment seems like the most plausible cause of stress in the impaired North Fork Pound River segment.

4.0 Analysis of Candidate Stressors for South Fork Pound River

The purpose of the stressor analysis is to look for a stressor that was present in the initial listing period of South Fork Pound River. South Fork Pound River was enlisted as impaired in 1994. The VaSCI ratings reported for all the stations located in South Fork Pound river shows that the benthic community is under severe stress. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat. Habitat metrics were very poor during the listing period for all of South Fork Pound River biological stations.

A list of candidate stressors was developed for South Fork Pound River and evaluated to determine the pollutant(s) responsible for the benthic impairment. The potential stressor checklist in Appendix A2 was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized in Appendix B2 as the basis for each potential stressor. Depending on the strength of available evidence, the potential stressors were either "eliminated", considered as "possible" stressors, or recommended as the "most probable" stressor(s). Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS/conductivity/sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

4.1. Eliminated Stressors

4.1.1. Ammonia

High values of ammonia are toxic to many fish species and may impact the benthic community as well. The values of ammonia recorded at station PNS003.38 which is just below the confluence with Glady Fork shows an apparent elevated level of ammonia in samples collected from 1976-79. However, a closer look at the data revealed a higher minimum analytical detection limit (MDL) of 0.10 mg/L, with most of the samples at or below the MDL. The samples collected in 2006 show ammonia at or below the current MDL of 0.04 mg/L. Hence ammonia was eliminated as a stressor.

4.1.2. Temperature

South Fork Pound River is classified as a Class IV mountain stream with a maximum temperature standard of 31°C. Although riparian vegetation in South Fork Pound River has received poor scores that could affect stream shading, riparian vegetation scores at the intermediate biological station – PNS003.94 – were not low and no exceedences of this standard have ever been recorded either in the DEQ or DMLR monitoring data sets. Therefore, temperature does not appear to be the cause of the benthic impairment and was eliminated as a possible stressor.

4.2. Possible Stressors

4.2.1. Hydrologic Modifications

Extensive mining has occurred, and is ongoing, in the watershed. Twenty-eight permitted sediment ponds are scattered throughout the watershed, and re-contoured reclaimed AML land exists in various parts of the watershed. Residential areas are primarily confined to the valley and floodplain corridor, along with the additions of roads and other impervious areas. The Donald Branch and Phillips Creek watersheds which are tributary to the South Fork Pound River have been almost totally mined with the aquatic habitat previously afforded by Donald Branch totally eliminated during the reclamation effort, as Donald Branch no longer exists as a surface feature. These modifications are all possible sources of stress on the biological communities along the South Fork Pound River.

4.2.2. Nutrients

Elevated nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macroinvertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. The average dissolved N concentration in 1976-79 was 0.73 mg/L which was approximately a median value for the state. In 2006, the average concentration has increased to 2.07 mg/L and is near the 92^{nd}-percentile state-wide. The benthic communities at all the stations have been dominated by nutrient loving organisms. The small amount of riparian vegetation near the outlet of the South Fork Pound River may also promote increased nutrient transport through surface runoff. The limiting nutrient for eutrophication in South Fork Pound River is phosphorus, but almost all phosphorus measurements are at or barely above its analytical MDL, and so is already at very low levels and, therefore, none of the measurements have even come close to DEQ's "threatened waters" threshold of 0.2 mg/L TP. N levels were fairly average at the time of initial listing, with increases being more recent and, while they may have possibly been related to the initial cause of stress on the biological community, the low availability of P make that unlikely. Nutrients are, therefore, considered to be a possible stressor.

4.2.3. Organic Matter

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macroinvertebrates. Potential sources of organic matter include household wastewater discharges, mining wastes, and agricultural runoff. High values of the modified family biotic index (MFBI) metric in South Fork Pound River are indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in all of the samples in South Fork Pound River– Hydropsychidae and Chironomidae – typical of organic-enriched sites, and the low ratios of scrapers to filterer-collectors, indicative of abundant suspended organic matter used as a food source for the filterer-collectors. Although there apparently are available sources of organic enrichment, no problems were monitored with DO depletion, and COD levels were minimal. Other organic indicators – low concentrations of TP, low volatile solids, and low TKN/TN fractions – did not support organics as a major source of stress. This situation could possibly be caused by organic contributions from malfunctioning septic systems and straight pipes, as the majority of residences in this watershed are not sewered and living in close proximity to streams. These organic inputs, therefore, could be at low concentrations and widely available as external food inputs to the benthic community. This could lead to a less diverse community that could have adapted to these chronic slightly elevated levels of organic and nutrient inputs. Organic matter is, therefore, considered to be a possible stressor.

4.2.4. pH

Benthic macroinvertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macroinvertebrates. Treated wastewater, acid mine drainage, acid rain, and urban runoff can potentially alter in-stream levels of pH. While no exceedences of the minimum or maximum pH standard were recorded at any of the DEQ stations or DMLR in-stream monitoring, DMLR groundwater monitoring revealed the potential for low pH values. pH was therefore considered to be a possible stressor, even though no in-stream violations have been recorded.

4.2.5. Toxics

The presence of toxics as a stressor in a watershed may be supported by very low numbers of any type of organisms, exceedences of freshwater aquatic life criteria or consensus-based Probable Effect Concentrations (PEC) for metals or inorganic compounds, by low percentages of the shredder population, reports of fish kills, or by the presence of available sources. The total numbers of benthic organisms in samples taken at the outlet of South Fork Pound River were low in several samples in the early 1990s. A known or suspected historical user and/or producer of toxic substances in the watershed is the mining industry. Nickel has been measured in exceedence of its consensus-based PECs at two stations in the South Fork Pound River, one downstream of South Fork middle sub-watershed in 2001 and another downstream from the Glady Fork subwatershed in 2006. The percentage of shredders at all the stations in the watershed has been low, but there have been no reports of fish kills or exceedences of any known aquatic life or human health criteria. Toxics are considered as a possible stressor although the available evidence does not precede the listing of this watershed in time. Therefore, toxics are considered to be a possible, but not one of the most probable, stressors.

4.3. Most Probable Stressors

The two most probable stressors to the benthic community are considered to be sediment and TDS/Conductivity/Sulfates based on the following summary of available evidence.

4.3.1. Sediment

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macroinvertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, runoff from abandoned mine land, construction sites, and in-stream disturbances. Although the %Haptobenthos metric has been low in a number of samples at both the upstream and downstream biological stations on South Fork Pound River the intermediate station had a very healthy population, although all of these samples were taken at different times in different years. Sediment is supported as a stressor through the poor habitat metrics related to sediment included bank stability, embeddedness, riparian vegetation, and sediment deposition. The only permitted point sources in the watershed are 3 instances of the 1000-gpd single family General Permit, whose contributions are minor, and the DMME mining permits, whose owners are required to install best management practices (BMPs) and to use sediment control measures to minimize erosion to the extent possible. As previous modeling on another mined watershed – Lick Creek – has indicated that actual sediment loads are far in excess of the nominal maximum daily sediment concentration of 70 mg/L, mining still appears to contribute large sediment loads, even when in compliance with their permits, which is further confirmed in the South Fork Pound River with large reported sediment concentrations in the DMLR monitored data. Therefore, sediment problems appear to be related to barren areas in the watershed that are subject to soil detachment and runoff. Disturbed permitted mining areas include recently cleared forested areas, land cleared for surface mining, and non-vegetated abandoned mine land (AML). Additionally, new construction, poorly vegetated riparian areas along streams, and in-stream disturbances would also add to the sediment load. This evidence supports the inclusion of sediment as one of the most probable stressors in the South Fork Pound River.

4.3.2. TDS/Conductivity/Sulfates

Average TDS, conductivity, and sulfate concentrations were greater then their respective screening values – 500 mg/L, 500 µmhos/cm, and 250 mg/L – at almost every active MPID with DMLR in-stream, sediment pond, and groundwater monitored data. Active DMLR in-stream, sediment pond, and groundwater monitoring sites were available for Rat/Short Creeks, Glady Fork, South Fork Middle, and South Fork Upper subwatersheds. DEQ ambient monitoring in 2006-07 at station PNS003.38 also showed conductivity and sulfate values above screening values (TDS was not monitored). Although the link between TDS/Conductivity/Sulfates and benthic community health is unclear, the very high levels are undoubtedly a contributor to the stress being shown by the benthic community at PNS000.40 and PNS004.98 along the South Fork Pound River, and is considered a most possible stressor.

5.0 Analysis of Candidate Stressors for Donald Branch and Phillips Creek

The purpose of the stressor analysis is to look for a stressor that was present during the listing periods of South Fork Pound River, Donald Branch and Phillips Creek. Donald Branch and Phillips Creek are headwaters of South Fork Pound River. Donald Branch and Phillips Creek were initially listed as impaired in 2002. The VaSCI ratings reported for all the stations located in South Fork Pound River shows that the benthic community is under severe stress. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat.

A list of candidate stressors was developed for Donald and Phillips Creek and evaluated to determine the pollutant(s) responsible for the benthic impairment. The potential stressor checklist in Appendix A3 was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized in Appendix B3 as the basis for each potential stressor. Depending on the strength of available evidence, the potential stressors were either "eliminated", considered as "possible" stressors, or recommended as the "most probable" stressor(s). Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS/conductivity/sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

5.1. Eliminated Stressors

5.1.1. Ammonia

High values of ammonia are toxic to many fish species and may impact the benthic community as well. There is no data for ammonia available at the outlet of Donald Branch and Phillips Creeks. However, all of the samples taken farther downstream on the South Fork Pound River were at or below the minimum analytical detection limit, and there is no known source of ammonia in the watershed, so it was eliminated as a potential stressor.

5.1.2. Temperature

Donald Branch and Phillips Creek are classified as Class IV mountain streams with a maximum temperature standard of 31°C. No exceedences of the standard were recorded either by DMLR monitoring in Phillips Creek or by DEQ monitoring at PNS008.73 during collection of the biological samples. The riparian vegetation metric measured during the habitat assessment at the outlet of Phillips Creek and Donald Branch (PNS003.78) further showed adequate cover in 1999 and has improved in 2006. Therefore, there is no evidence supporting temperature as a stressor, so it was eliminated.

5.2. Possible Stressors

5.2.1. Nutrients

Excessive nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macroinvertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. In Donald Branch and Phillips Creek, the benthic community is overwhelming dominated by Chironomidae, although its numbers have decreased and diversity has increased since 1999. Although this organism is often found in streams with elevated nutrients, there are no known sources of non-natural nutrients in this watershed, with the possible exception of fertilization on reclaimed AML areas, which is usually a one-time application at recommended rates. TP levels at downstream stations on the South Fork Pound River are at very low levels, so phosphorus does not appear to be a stressor. Nutrients are left in as a possible stressor because of the possibility of contributions of nitrogen in runoff from fertilized AML area, though there is no data available to further evaluate this possible source of stress.

5.2.2. Organic Matter

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macroinvertebrates. Potential sources of organic matter in these watersheds are expected to be minor and related to mining operation wastes. Moderate to high values of the modified family biotic index (MFBI) metric may be indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in all of the samples in South Fork Pound River– Chironomidae, and Simuliidae – typical of organic-enriched sites, and the high percentage of filter-collectors that rely on suspended organic matter as their food source. No data was available for BOD_5 or COD, but dissolved oxygen levels recorded during biological samples were in compliance with the DO standard. Organic matter is considered to be a possible stressor, though its exact source is unknown.

5.2.3. pH

Benthic macroinvertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macroinvertebrates. Treated wastewater, acid mine drainage, and acid rain can potentially alter in-stream levels of pH. Although no exceedences of the minimum or maximum pH standard were reported in DMLR in-stream monitoring within Phillips Creek or at station PNS008.73 corresponding with the biological samples, DMLR groundwater pH values frequently exceeded the minimum pH limit and could influence in-stream pH values. Therefore, pH was considered to be a possible stressor.

5.2.4. Sediment

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macroinvertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, runoff from abandoned mine land, construction sites, and in-stream disturbances. Low concentrations of TSS have been recorded by DMLR in-stream and groundwater monitoring in the watersheds, though the representation of runoff events is unknown. Riparian vegetation and sediment deposition metric scores were good for all habitat assessments, and much AML land has been reclaimed. However, there is, and has been, mining activity in the majority of the watershed for the past 30-some years that has entailed much land disturbance. The %Haptobenthos (organisms that require clean, coarse substrate) was low at the outlet of Donald Branch and Phillips Creek in 1999, but increased from 1999 to 2006, along with the habitat bank stability metric. Excess sedimentation in the watershed appears to be related to disturbed or barren areas in the watershed that are subject to soil detachment and runoff. These include recently cleared forested areas, land cleared for surface mining, non-vegetated abandoned mine land (AML), and poorly vegetated riparian areas along streams. Because of the nature of the dominant activity in the watershed – mining – sediment must be considered a possible stressor, even though direct supportive measured evidence is not available.

5.2.5. Toxics

The presence of toxics as a stressor in a watershed may be supported by very low numbers of any type of organisms, exceedences of freshwater aquatic life criteria or consensus-based Probable Effect Concentrations (PEC) for metals or inorganic compounds, by low percentages of the shredder population, reports of fish kills, or by the presence of available sources. The shredder population was reported to be very low, but there have been no reports of fish kills. The benthic organism sample counts taken at the outlet of Donald Branch and Phillips Creek are also typical of streams without a toxics problem. Toxics are considered as a possible stressor because of the dominating presence of the mining industry in the watershed – a known user and producer of toxic substances.

5.3. Most Probable Stressors

The two most probable stressors to the benthic community are considered to be hydrologic modifications and TDS/conductivity/sulfates based on the following summary of available evidence.

5.3.1. Hydrologic Modifications

The complete alteration and rearrangement of the hydrology in the Phillips Creek and Donald Branch watersheds is the most probable stressor on the biological community. Donald Branch has been modified to such an extent, that it no longer exists as a surface feature and all drainage from the former watershed is entirely subsurface, resulting in the elimination of all stream habitat in this watershed. The removal of all upstream habitat in the Donald Branch watershed has undoubtedly affected the population available for populating downstream habitat as assessed at PNS008.73.

5.3.2. TDS/Conductivity/Sulfates

The average TDS and conductivity measurements reported in DMLR in-stream and groundwater monitoring data for Phillips Creek watershed were greater than the screening values of 500 mg/L and 500 µmhos/cm, respectively. Sulfate values were greater than the screening value of 250 mg/L for Phillips Creek for in-stream monitoring. Although the link between TDS/Conductivity/Sulfates and benthic community health is unclear, the very high levels are undoubtedly a contributor to the stress being shown by the benthic community at PNS008.73.

6.0 Conclusions

The aquatic life impairment on the North Fork Pound River stream segment (VAS-Q13R-02) is relatively minor, with individual VaSCI sample scores varying between 35.0 and 65.9 and an average score of 55.4 for samples in 2006. This segment is located downstream from the North Fork Pound Lake, which does not appear to be a source of pollutants and serves as a disconnect from far upstream mining activities. The impaired segment only has ambient data for 2006-07 and has a 6-yr gap in the biological data. Stacy Branch is a major tributary to the impaired segment. Recent monitoring has shown that contributions from Stacy Branch appear to be no different than the watershed as a whole. The impaired segment is poorly buffered with alkalinity measurements below 20 mg/L, but does not appear to have any immediate threats from sources of acidity. Sediment was selected as the most probable stressor based on the repeated poor scores for sediment metrics in the habitat assessments.

The aquatic life impairment on the South Fork Pound River stream segment (VAS-Q13R-01) has shown consistently low values of the VaSCI with a 2006 average of 33.1. Extensive mining and reclamation have also impacted this watershed. While this watershed has more ambient data than the others, it also has a 26-yr gap in ambient data between 1980 and 2006, and irregular biological samples between 2000 and 2006. There are 3 biological monitoring sites along this segment. Although samples from these stations vary in time, the intermediate station is characterized by slightly better habitat and benthic community metrics than at the upstream and downstream sites. Although TP measurements are at barely detectable levels, nitrogen levels have increased over time. The source of nitrogen is unknown, but does not appear to be the major stressor. High monitored TSS concentrations from DMLR monitoring and poor habitat metrics led to the selection of sediment as a most probable stressor, and widespread elevated levels of the TDS/Conductivity/Sulfate suite of parameters led to its inclusion as well as most probable stressors.

The aquatic life impairment on Donald Branch and Phillips Creek (VAS-Q13R-04) is quite severe with a 3-sample VaSCI average score of 15.1. The hydrology in these watersheds has been radically altered through extensive mining and reclamation. Almost the entire watershed is included in various mining permits. The Donald Branch watershed has been subject to extensive re-mining to the extent that Donald Branch no longer exists as a surface feature. This has resulted in the elimination of all lotic aquatic habitat in this watershed which also affects downstream propagation of these organisms. No ambient data is available for these watersheds, and a 7-yr gap exists between the first and the last two biological samples. All measurements of the TDS/Conductivity/Sulfate suite of parameters have been extremely high. Hydrologic modifications and the TDS/conductivity/sulfates suite have been selected as the most probable stressors on this impaired segment.

7.0 References

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Appendix A1. North Fork Pound River - Potential Stressor Checklist

Ammonia

- High ammonia values (variable pH and temperature dependent WQS)? ....**N**

Hydrologic Modifications

- Mining impacts are far upstream and separated by the North Fork Pound Lake.
- The North Fork Pound Lake has controlled discharges between October and December each year in order to draw down the lake to have capacity for storage against spring flooding.
- Crowding of buildings into narrow flood plains along the impaired segment downstream of the lake.

Nutrients

Benthic Data

- Dominance of Chironomidae, Hydropsychidae or Simuliidae (see Table 2.2)? (may indicate elevated nutrients) **All three are dominant on different dates**...............................**Y____**
- Dominance of algae-eating fish species, e.g. Central Stonerollers? ....____
- Degree of dominance: %2Dom usually < 70%; frequently 1 of 2 dominant organisms have pollutant tolerance ratings of 2 or 4.

Habitat Data

- Low Riparian Vegetation habitat score (see Table 2.5)? (may allow increased nutrient inputs from overland flow) **5 out of 16 instances**..**____Y**
  - o **The riparian vegetation had higher scores since 1999.**

Chemical/Physical Data (PNK000.08, PNK001.10)

- Average N and P ambient data (DEQ) – eutrophic sufficiency levels: Dissolved_N > 0.3 mg/L; Dissolved P > 0.01 mg/L (Table 2.8)?
  - o Dissolved N: Averages at both the stations were greater than 0.3 mg/L. Dissolved N increased from 0.73 to 2.07 from 1976-79 to 2006-07 at PNS003.38.
  - o Dissolved P: No dissolved P measurements at PNS003.94 or at PNS003.38 before 2006; all dissolved_P at PNS003.38 from 2006-07 were at or below its 0.05 mg/L MDL.
- Limiting nutrient (N:P > 10 indicates P is limiting; N:P < 4 indicates N is limiting.) (Table 2.8). **The average N:P ratios indicate P as the limiting nutrient at all locations and times; however, the N:P is marginally > 10, but inconclusive, as most TP concentrations represent unknown values below their MDLs.**
- DEQ Wastewater Facility Sampling Inspection Reports? ....____
- Exceedence of DEQ's "threatened waters" TP threshold (Table 2.19)? ....**N____**

Ancillary Data

- Ranking of Nutrient Loads in DCR's Biennial NPS Assessment (see Table 2.20):
  - o AG_N rating? **L** ____; AG_P rating? **L_____**
  - o URB_N rating? **H____**; URB_P rating? **H_____**
  - o FOR_N rating? **H____**; FOR_P rating? **H_____**

- TOT_N rating? **L____**; TOT_P rating? **M_____**

Field Observations

- Observed growth/slime/algae in streams? ...._____

Organic Matter

Benthic Data

- Moderate to high values of the MFBI metric (>≈5.00) may indicate organic pollution (see Table 2.4)? **For PNK000.08 MFBI >= 4 / 11 samples pre-07/98**...........................**Y__/__**
  - The MFBI metrics have all been lower than 5 since 1998.
- Dominance of Hydropsychidae or Simuliidae organisms (see Table 2.2)? (indicates moderate organic or nutrient pollution)...**Y___**
  - Hydropsychidae has been dominant in all seasons except summers.
  - Simuliidae was dominant in 1992, and then in 2006.
  - Fairly low degree of dominance, usually %2Dom < 70%.
- Presence of Asellidae, Oligochaetae, or Tubificidae organisms (see Table 2.2)? **A single Tubificidae organism was observed on two occasions in the early nineties.** ....**Y___**
- A low value (<≈0.50) for the SC/CF Ratio metric (see Table 2.2) or a high number of filterer-collectors (FC) indicates availability of suspended Fine Particulate Organic Matter? **SC/SF <=0.5 in 11/ 17 samples, SC/SF was less than 0.5 in 2006 but greater than 0.5 from 98-00. %FC >50% on 8 out of 17 occasions. Always> 24%** ....**Y__/__**

Chemical/Physical Data

- High TOC values? – (GW criteria = 10 mg/L)...**N_____**
- High Volatile Solids and high BOD_5 values? (combination indicative of organics)....._____
- High BOD_5 values? (Chickahominy effluent standard: 6-8 mg/L) ...._____
- High COD values? (Chickahominy effluent standard: 10 mg/L) ....**N____**
- Low DO values (Class IV Waters WQS: average 5.0 mg/L)? ....**N____**
- High levels of TKN relative to nitrate-N indicating larger % organic N (Table 2.8)? .**Y___**
  - **Yes, but both TKN and TN values are relatively low.**

Ancillary Data

- Large diurnal DO fluctuations? (> 1/3 %Saturation).._____

Observations

- Extensive livestock access to streams or observed livestock manure in creeks? ....**N____**

pH

- Extreme field pH values? – (normal range: 6.0 – 9.0)...**N____**
- Extreme alkalinity values? (Valley & Ridge GW Criteria: 30-500 mg/L).................**Y____**
  - **The average values of alkalinity are very low – 17.6 and 10.5 mg/L – at PNK001.10 and PNK000.08, which are upstream and downstream of Stacys Branch, respectively. Although there appears to be no pH problem, this stream segment is poorly buffered and could be susceptible to pulses of acidity from acid rain or AMD.**

Sediment

Benthic Data

- Low %Haptobenthos metric (implies a lack of clean, coarse substrates, see Table 2.2)? .... **N___**
    - The %Haptobenthos dropped below 30% between spring 1994 and summer 1998. However, the population of Haptobenthos increased to 90.1% in 2001 and then decreased to 36.1% and 43.1% in the spring and fall 2006 samples.

Habitat Data

- Habitat Evaluation Scores (0 = worst; 20 = best). Bedload sediment may be indicated by low scores of low <u>bank stability</u>, <u>embeddedness</u>, <u>riparian vegetation</u>, and/or <u>sediment deposition</u> scores (see Table 2.5)? .... **Y___**
    - Bank stability and riparian vegetation increased in 2006 compared to earlier observations.
    - Embeddedness and sediment deposition scores stayed poor.

Physical/Chemical Data

- High ambient TSS concentrations or turbidity?... **N____**
- High TSS concentrations or turbidity during runoff events?......................................._N__

Ancillary Data

- Ranking of Sediment Loads in DCR's Biennial NPS Assessment (see Table 2.20):
    - AG_S rating? ____**L**
    - URB_S rating? ____**H**
    - FOR_S rating? ____**H**
    - TOT_S rating? ____**M (Low in 2002, 2004)**
    - Riverine Impairment (streambank erosion)? **L in 2006, 2004, and M in 2002__**

- Low Riffle Stability Index (indicating anthropogenic influences)? ....____
- Presence of silt-intolerant fish species? ....____

Field Observations

- Observed stream embeddedness? ....____
- Observed construction sites?..____
- Observed forest harvesting sites?...____
- Observed clean-tillage farming?...____
- Observed livestock access to streams and trampled streambanks? ...._N__

TDS/Conductivity/Sulfates

- DMLR NPDES Monitoring
    - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....____
    - High TDS values? (reference watershed screening value < 500 mg/L) ....____
    - High sulfate values? (reference watershed screening value < 250 mg/L) ....____
    - Comparison with reference watershed values?
- DMLR In-stream Monitoring
    - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....____
    - High TDS values? (reference watershed screening value < 500 mg/L) ....____
    - High sulfate values? (reference watershed screening value < 250 mg/L) ....____
    - Comparison with reference watershed values?

- DMLR Groundwater Monitoring
  - o High conductance values? (reference watershed screening value < 500 µmhos/cm) ....____
  - o High TDS values? (reference watershed screening value < 500 mg/L) ....____
  - o High sulfate values? (reference watershed screening value < 250 mg/L) ....____
  - o Comparison with reference watershed values?
- Other? (Please describe). The values of TDS, Conductivity and sulfates reported by DMLR NPDES monitoring, In-stream monitoring and groundwater monitoring in Upper North Fork watershed were greater than the screening values, but are separated by the North Fork Pound Lake and are not reflected in values below the dam.
- DEQ
  - o Conductance...N__
  - o TDS ....____
  - o Sulfate ....N__

Temperature

- High summer water Temperature values? (Class V Waters WQS = 21°C) ....**Y**____
- Low <u>riparian vegetation</u> score in Habitat Evaluation (see Table 2.5)? **(5 / 16 times)**. **The riparian vegetation scores have improved since 1999. ....**_Y__

Toxics

Benthic Data

- Low Shredder/Total metric (see Table 2.2) may indicate toxic affects, especially when adsorbed to the CPOM, or may indicate lack of available habitat?..............................____
- Low numbers of total organisms? (see Table 2.2)..**N**____
  - o Low counts of organisms were recorded twice – spring 1994 and spring 1998.

Chemical/Physical Data

- Exceedences of EPA's Aquatic Life or Human Health Criteria?................................**N**___
- Exceedences of Consensus-based Probable Effect Concentrations (PECs) by sediment samples (see Table 2.9)?...**N**____
- Chlorides (Rappahannock Effluent WQS- 40 mg/L; Chronic Aquatic Life Criteria: chloride - 230 mg/L) ....**N**____
- Ammonia violations?..**N**____

Permitted Point Source Data

- DEQ Permitted Point Source Dischargers (RCRIS, CWNS, or VPDES sites)? .... **_N__**
- DMLR Permitted Point Source Dischargers (RCRIS, CWNS, or VPDES sites)? ...... **_N__**
- Known or suspected historical users of toxic substances in the watershed? ....____

Ancillary Data

- High mortality rates indicated by EPA laboratory toxicity tests with *Ceriodaphnia* and fathead minnow (or other sensitive species)? ....____
- High % toxicity calculated from STP bench sheets?..____
- Problems reported in VCE-sponsored County Household WQ Survey?......................____

Field Observations

- Absence of fish?...____

Appendix A2. South Fork Pound River - Potential Stressor Checklist

Ammonia

- High ammonia values (variable pH and temperature dependent WQS)? ....**N____**

Hydrologic Modifications

- Mining impacts: extensive AML and permitted mining land in the watershed.
- Residential areas are primarily in the narrow flood plains at certain locations in the watershed.

Nutrients

Benthic Data

- Dominance of Chironomidae, Hydropsychidae or Simuliidae (see Table 2.3)? (may indicate elevated nutrients)..**Y____**
    - o Hydropsychidae has been the dominant species for all the samples. Simuliidae was dominant once in 1991. Chironomidae has been dominant in some samples.
- Dominance of algae-eating fish species, e.g. Central Stonerollers? ....____

Habitat Data

- Low Riparian Vegetation habitat score (see Table 2.6)? (may allow increased nutrient inputs from overland flow) ....**Y____**

Chemical/Physical Data

- N and P ambient data (DEQ) – eutrophic sufficiency levels: Dissolved_N > 0.3 mg/L; Dissolved P > 0.01 mg/L (Table 2.8)?
    - o Dissolved N: Averages at both the stations were greater than 0.3 mg/L. Dissolved N increased from 0.73 to 2.07 from 1976-79 to 2006-07 at PNS003.38.
    - o Dissolved P: No dissolved P measurements at PNS003.94 or at PNS003.38 before 2006; all dissolved_P at PNS003.38 from 2006-07 were at or below its 0.05 MDL.
- Limiting nutrient (N:P > 10 indicates P is limiting; N:P < 4 indicates N is limiting.) The average N:P ratios indicate P as the limiting nutrient at all locations and times. ....**P.**
    - o Dissolved P is already at very low concentrations, but would be limiting for biological growth.
- DEQ Wastewater Facility Sampling Inspection Reports? ....____
- Exceedence of DEQ's "threatened waters" TP threshold (Table 2.19)? ....____
- Exceedence of 0.2 mg/L since latest 305 (b) assessment?...**N**

Ancillary Data

- Ranking of Nutrient Loads in DCR's Biennial NPS Assessment (see Table 2.20):
    - o AG_N rating? **L____**; AG_P rating? **L_____**
    - o URB_N rating? **H____**; URB_P rating? **H_____**
    - o FOR_N rating? **H____**; FOR_P rating? **H_____**
    - o TOT_N rating? **L____**; TOT_P rating? **M_____**

Field Observations

- Observed growth/slime/algae in streams? ...._____

Organic Matter

Benthic Data

- Moderate to high values of the MFBI metric (>≈5.00) may indicate organic pollution (see Table 2.4)?
  - **PNS000.40: 12/16 samples > 5; all samples since 2000 >5.........................._Y__**
  - **PNS003.94: Both samples < 5..._N__**
  - **PNS004.98: All (3) samples > 5 ...._Y__**
- Dominance of Hydropsychidae or Simuliidae organisms (see Table 2.3)? (indicates moderate organic or nutrient pollution)...**Y___**
  - **At all the stations in the watershed**
- Presence of Asellidae, Oligochaetae, or Tubificidae organisms (see Table 2.3)?........**Y___**
  - **PNS000.40: one Tubificidae was observed in two samples (1990, 2006).**
- A low value (<≈0.50) for the SC/CF Ratio metric (see Table 2.3) or a high number of filterer-collectors (FC) indicates availability of suspended Fine Particulate Organic Matter?
  - PNS00.40: ave. SC/CF = 0.12; ave. %FC = 86.4%..**_Y__**
  - PNS03.94: ave. SC/CF (both samples > 1.00); ave. %FC (both samples < 50%)_N_
  - PNS04.98: ave. SC/CF (both 2006 samples = 0.03); %FC = 60-85% ....**_Y__**

Chemical/Physical Data

- High TOC values? – (GW criteria = 10 mg/L)..______
  - **One value (14.5 mg/L) was recorded at PNS003.94.**
- High Volatile Solids and high BOD_5 values? (combination indicative of organics)....**_N__**
  - **No BOD5 measurements; low VS and low VS/TS.**
- High BOD_5 values? (Chickahominy effluent standard: 6-8 mg/L) ...._____
- High COD values? (Chickahominy effluent standard: 10 mg/L)................................_____
- Low DO values (Class IV Waters WQS: average 5.0 mg/L)? ....**_N__**
- High levels of TKN relative to nitrate-N indicating larger % organic N (Table 2.8)?.**_N__**

Ancillary Data

- Large diurnal DO fluctuations? (> 1/3 %Saturation)..._____

Observations

- Extensive livestock access to streams or observed livestock manure in creeks? ...._____

Some livestock activity in some of the reclaimed AML areas, especially Big Branch.

pH

- Extreme DEQ ambient field pH values? – (normal range: 6.0 – 9.0).........................N_____
- Extreme DEQ biological field pH values? – (normal range: 6.0 – 9.0)......................N_____
- Extreme DMLR in-stream pH values? – (normal range: 6.0 – 9.0) ....N_____
- Extreme DMLR groundwater pH values? – (normal range: 6.0 – 9.0) ....Y_____
- Extreme alkalinity values? (Valley & Ridge GW Criteria: 30-500 mg/L)................**N**_____

Sediment

Benthic Data

- Low % Haptobenthos metric (implies a lack of clean, coarse substrates, see Table 2.3)?
  - **PNS000.40: 3/16 < 30%.** ....**__?__**
  - **PNS003.94: both 2001 samples > 70%** ....**__N__**
  - **PNS004.98: 1/3 < 30% ....__?__**

Habitat Data

- Habitat Evaluation Scores (0 = worst; 20 = best). Bedload sediment may be indicated by low scores of low <u>bank stability</u>, <u>embeddedness</u>, <u>riparian vegetation</u>, and/or <u>sediment deposition</u> scores (see Table 2.6)? **All are reported low on several occasions.** ....___

Physical/Chemical Data

- High DEQ TSS concentrations or turbidity during runoff events?
  - PNS003.38: 1976-79 (5/18 > 100 mg/L, one at 3,300 mg/L); 2006-07 (10 samples – range 3-5 mg/L) ...._Y__
  - PNS003.94: 1 sample = at or below 3 mg/L MDL ...._N__
- High DMLR TSS concentrations or turbidity?
  - Sediment Pond NPDES monitoring (all MPID averages < 31 mg/L) ...._N__
  - In-stream monitoring (all MPID averages < 20 mg/L)...................................._N__
  - Groundwater monitoring (average at 1/24 sites > 100 mg/L) ...._N__

Ancillary Data

- Ranking of Sediment Loads in DCR's Biennial NPS Assessment (see Table 2.20):
  - AG_S rating? **L____**
  - URB_S rating? **H____**
  - FOR_S rating? **H____**
  - TOT_S rating? **M____**
  - Riverine Impairment (streambank erosion)? ____

- Low Riffle Stability Index (indicating anthropogenic influences)? ....____
- Presence of silt-intolerant fish species? ....____

Field Observations

- Observed stream embeddedness? ....____
- Observed construction sites?..____
- Observed forest harvesting sites?..____
- Observed clean-tillage farming?..____
- Observed livestock access to streams and trampled streambanks? ....____

TDS/Conductivity/Sulfates

- DMLR NPDES Monitoring
  - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....**Y____**
  - High TDS values? (reference watershed screening value < 500 mg/L) ....**Y____**
  - High sulfate values? (reference watershed screening value < 250 mg/L) ......**Y____**
  - Comparison with reference watershed values?
- DMLR In-stream Monitoring
  - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....**Y____**
  - High TDS values? (reference watershed screening value < 500 mg/L) ....**Y____**

- High sulfate values? (reference watershed screening value < 250 mg/L) ......**Y**____
- Comparison with reference watershed values?

- DMLR Groundwater Monitoring
  - High conductance values? (reference watershed screening value < 500 μmhos/cm) ....**Y**____
  - High TDS values? (reference watershed screening value < 500 mg/L) ....**Y**____
  - High sulfate values? (reference watershed screening value < 250 mg/L) ......**Y**____
  - Comparison with reference watershed values?
- DEQ (PNS003.38 only)
  - Conductance.._Y__
  - TDS ....NA
  - Sulfates.._Y__

Temperature

- High summer water Temperature values? (Class IV Waters WQS = 31°C) ...._**N**__
- Low <u>riparian vegetation</u> score in Habitat Evaluation (see Table 2.6)?
  - PNS000.40: average 7.8.._**Y**__
  - PNS003.94: average 11.0.._N__
  - PNS004.98: average 8.3.._**Y**__

Toxics

Benthic Data

- Low Shredder/Total metric (see Table 2.3) may indicate toxic affects, especially when adsorbed to the CPOM, or may indicate lack of available habitat?...........................__N__
- Low numbers of total organisms? (see Table 2.3)..__Y__
  - **Several low totals in early 1990's.**

Chemical/Physical Data

- Exceedences of EPA's Aquatic Life or Human Health Criteria? ...._N__
- Exceedences of Consensus-based Probable Effect Concentrations (PECs) by sediment samples (see Table 2.9)?
  - PNS003.38: 1 of 2 samples for Nickel – exceedence in 2006 ...._Y (Ni)_
  - PNS003.94: 1 of 2 samples for Nickel – exceedence in 2001 ...._Y (Ni)_
- Chlorides (Rappahannock Effluent WQS- 40 mg/L; Chronic Aquatic Life Criteria: chloride - 230 mg/L) ....**N**____
- Ammonia violations? ....**N**____

Permitted Point Source Data

- Permitted Point Source Dischargers (RCRIS, CWNS, or VPDES sites)?
  - DEQ: only 4 1000-gpd general permits ...._N__
  - DMLR: 13 active mining permits ...._Y__
- Known or suspected historical users of toxic substances in the watershed? ....____

Ancillary Data

- High mortality rates indicated by EPA laboratory toxicity tests with *Ceriodaphnia* and fathead minnow (or other sensitive species)? ....____
- High % toxicity calculated from STP bench sheets? ....____

- Problems reported in VCE-sponsored County Household WQ Survey?......................____

Field Observations

- Absence of fish?..____

Appendix A3. Donald Branch and Phillips Creek - Potential Stressor Checklist

Ammonia

- High ammonia values (variable pH and temperature dependent WQS)? .... ____

Hydrologic Modifications

- Mining impacts: Extensive areas of the watershed have been modified through surface mining; many areas are, or were AML, and almost the entire area is permitted for mining.

Nutrients

Benthic Data

- Dominance of Chironomidae, Hydropsychidae or Simuliidae (see Table 2.3)? (may indicate elevated nutrients) .... **Y**_
- Dominance of algae-eating fish species, e.g. Central Stonerollers? .... ____

Habitat Data

- Low Riparian Vegetation habitat score (see Table 2.6)? (may allow increased nutrient inputs from overland flow) .... **N**____

Chemical/Physical Data **(No corresponding ambient station!)**

- N and P ambient data (DEQ) – eutrophic sufficiency levels: Dissolved_N > 0.3 mg/L; Dissolved P > 0.01 mg/L (Table 2.8)? .... ____
- Limiting nutrient (N:P > 10 indicates P is limiting; N:P < 4 indicates N is limiting.) The average N:P ratios indicate P as the limiting nutrient at all locations and times. .... ____
- DEQ Wastewater Facility Sampling Inspection Reports? .... ____
- Exceedence of DEQ's "threatened waters" TP threshold (Table 2.19)? .... ____
- Exceedence of 0.2 mg/L since latest 305 (b) assessment? .... ____

Ancillary Data

- Ranking of Nutrient Loads in DCR's Biennial NPS Assessment (see Table 2.20):
  - AG_N rating? **L**____; AG_P rating? **L**_____
  - URB_N rating? **H**____; URB_P rating? **H**_____
  - FOR_N rating? **H**____; FOR_P rating? **H**_____
  - TOT_N rating? **L**____; TOT_P rating? **M**_____

Field Observations

- Observed growth/slime/algae in streams? .... ____

Organic Matter

Benthic Data

- Moderate to high values of the MFBI metric (>≈5.00) may indicate organic pollution (see Table 2.4)? .... **3/3**__
- Dominance of Hydropsychidae, Chironomidae, or Simuliidae organisms (see Table 2.3)? (indicates moderate organic or nutrient pollution) .... **Y**___

- Presence of Asellidae, Oligochaetae, or Tubificidae organisms (see Table 2.3)?........**N**___
- A low value (<≈0.50) for the SC/CF Ratio metric (see Table 2.3) or a high number of filterer-collectors (FC) indicates availability of suspended Fine Particulate Organic Matter? ....**Y**___
  - **%FC always greater than 95% > 90%; no scrapers identified in any of the 3 samples.**

Chemical/Physical Data
- High TOC values? – (GW criteria = 10 mg/L)..._____
- High Volatile Solids and high BOD_5 values? (combination indicative of organics)....._____
- High BOD_5 values? (Chickahominy effluent standard: 6-8 mg/L) ...._____
- High COD values? (Chickahominy effluent standard: 10 mg/L)................................_____
- Low DO values (Class IV Waters WQS: average 5.0 mg/L)? ...._N__
- High levels of TKN relative to nitrate-N indicating larger % organic N?...................._____

Ancillary Data
- Large diurnal DO fluctuations? (> 1/3 %Saturation).._____

Observations
- Extensive livestock access to streams or observed livestock manure in creeks? ...._N__

pH
- Extreme DEQ ambient field pH values? – (normal range: 6.0 – 9.0)........................._____
- Extreme DEQ biological field pH values? – (normal range: 6.0 – 9.0).....................N____
- Extreme DMLR in-stream pH values? – (normal range: 6.0 – 9.0) ....N____
- Extreme DMLR groundwater pH values? – (normal range: 6.0 – 9.0) ....**Y**____
- Extreme alkalinity values? (Valley & Ridge GW Criteria: 30-500 mg/L)................**N**____

Sediment

Benthic Data
- Low % Haptobenthos metric (implies a lack of clean, coarse substrates, see Table 2.3)? **The value of % Haptobenthos was very low (1.8% in 1999 and increased to 26.4% in 2006.** ...._Y_

Habitat Data
- Habitat Evaluation Scores (0 = worst; 20 = best). Bedload sediment may be indicated by low scores of low <u>bank stability</u>, <u>embeddedness</u>, <u>riparian vegetation</u>, and/or <u>sediment deposition</u> scores (see Table 2.6)?
  - Bank stability was low in 1999, but increased in 2006
  - Embeddedness decreased from 1999
  - Riparian vegetation, bank vegetation, and sediment deposition scores were high

Physical/Chemical Data
- High TSS concentrations or turbidity during runoff events?......................................._____
- High background or ambient TSS concentrations or turbidity?
  - DEQ (no data)..._____
  - DMLR.._N__

Ancillary Data
- Ranking of Sediment Loads in DCR's Biennial NPS Assessment (see Table 2.20):

- AG_S rating? **L**____
- URB_S rating? **H**____
- FOR_S rating? **H**____
- TOT_S rating? **M**____
- Riverine Impairment (streambank erosion)? ____

- Low Riffle Stability Index (indicating anthropogenic influences)? ....____
- Presence of silt-intolerant fish species? ....____

Field Observations

- Observed stream embeddedness? ....____
- Observed construction sites? (mining)..._Y__
- Observed forest harvesting sites?...____
- Observed clean-tillage farming?...____
- Observed livestock access to streams and trampled streambanks? ...._N__

TDS/Conductivity/Sulfates

- DMLR NPDES Monitoring (no data)
  - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....____
  - High TDS values? (reference watershed screening value < 500 mg/L) ....____
  - High sulfate values? (reference watershed screening value < 250 mg/L) ....____
  - Comparison with reference watershed values?
- DMLR In-stream Monitoring (5 MPIDs)
  - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....**Y**____
  - High TDS values? (reference watershed screening value < 500 mg/L) ....**Y**____
  - High sulfate values? (reference watershed screening value < 250 mg/L) ......**Y**____
  - Comparison with reference watershed values?
- DMLR Groundwater Monitoring (5 MPIDs)
  - High conductance values? (reference watershed screening value < 500 µmhos/cm) ....**Y**____
  - High TDS values? (reference watershed screening value < 500 mg/L) ....**Y**____
  - High sulfate values? (reference watershed screening value < 250 mg/L) ......**N**____
  - Comparison with reference watershed values?
- DEQ
  - Conductance..._Y__
  - TDS ....____
  - Sulfates..____

Temperature

- High summer water Temperature values? (Class IV Waters WQS = 31°C) ....**N**____
- Low riparian vegetation score in Habitat Evaluation (see Table 2.6)?.......................**N**____
- Other? (Please describe)

Toxics

Benthic Data

- Low Shredder/Total metric (see Table 2.3) may indicate toxic affects, especially when adsorbed to the CPOM, or may indicate lack of available habitat?............................**Y____**
  - **1.9% in 2006; overall diversity was very low.**
- Low numbers of total organisms? (see Table 2.3)...**N____**

Chemical/Physical Data

- Exceedences of EPA's Aquatic Life or Human Health Criteria?..................................___
- Exceedences of Consensus-based Probable Effect Concentrations (PECs) by sediment samples (see Table 2.9)?..____
- Chlorides (Rappahannock Effluent WQS- 40 mg/L; Chronic Aquatic Life Criteria: chloride - 230 mg/L)...____
- Ammonia violations?...____

Permitted Point Source Data

- Permitted Point Source Dischargers (RCRIS, CWNS, or VPDES sites)?.....................____
- Known or suspected historical users of toxic substances in the watershed? (mining) ._Y__

Ancillary Data

- High mortality rates indicated by EPA laboratory toxicity tests with *Ceriodaphnia* and fathead minnow (or other sensitive species)?..____
- High % toxicity calculated from STP bench sheets?...____
- Problems reported in VCE-sponsored County Household WQ Survey?......................____

Field Observations

- Absence of fish?...____

Appendix B1. Stressor Analysis Evidence Sheet for North Fork Pound River

Ammonia:

- Supportive:
- Non-supportive: None of the samples were above the 0.04 mg/L MDL for ammonia.

Hydrologic Modifications:

- Supportive: crowding of buildings into narrow flood plains was observed along the impaired segment downstream of North Fork Pound River; creation of the North Fork Pound Lake; controlled lake discharges between October and December to increase storage capacity for spring runoff.
- Non-supportive:

Nutrients:

- Supportive: Minor degree of dominance by nutrient-loving benthic organisms; low riparian vegetation could increase nutrient contributions from surface runoff prior to 1999; the medium ranking in DCR's NPS assessment for TP; High TN and TP rating from Urban sources.
- Non-supportive: Total P is at or below the (0.01 mg/L) Minimum Detection Limit for most of the samples. Total N concentrations are among the lowest in the state. No reported TP concentrations in excess of Virginia's "threatened waters" 0.2 mg/L threshold.

Organic Matter:

- Supportive: Several moderate to high values of the MFBI at PNK000.08 prior to 1998; minor dominance by the organic-loving Hydropsychidae and Chironomidae organisms; a single Tubificidae organism was observed in two samples in the early 1990s; %filterer-collectors was > 50% in many samples prior to 1998
- Non-supportive: No problems with DO level. Frequent dominance by organisms with low pollution tolerance (2 – 4).

pH:

- Supportive:
- Non-supportive: No pH exceedences.

Sediment:

- Supportive: poor habitat scores for bank stability, embeddedness, riparian vegetation, and sediment deposition metrics; medium ranking for total sediment in DCR's NPS assessment; high TSS concentrations associated with high flow at one DMLR monitoring site far above the lake.
- Non-supportive: Small TSS concentrations from DEQ ambient and upstream DMLR sediment pond monitoring data; a healthy population of Haptobenthos for most of the sampling period.

TDS/Conductivity/Sulfates:

- Supportive: Average TDS, conductivity, and sulfate concentrations were greater then their respective screening values at almost every MPID for DMLR in-stream, sediment pond, and groundwater monitored data at headwater sites.

- Non-supportive: DEQ monitoring along the impaired segment showed background concentrations of conductivity and sulfates (TDS was not monitored). North Fork Pound Lake separated the active mining sites from the downstream impaired segment.

Temperature:

- Supportive: Low riparian vegetation habitat metric values, which could reduce shading. All 5 monthly ambient temperature observations monitored by DEQ in the summers of 2006 and 2007 exceeded the Class V water quality standard of 21°C.
- Non-supportive: The WQS was developed for fish habitat, not benthic macroinvertebrates. Many Class IV waters support healthy benthic communities, so there is no reason to believe that these elevated temperatures (still within the Class IV standard) would be a stressor.

Toxics:

- Supportive: Several samples had counts of total organisms in the spring 1994 and spring 1998.
- Non-supportive: No reported fish kills; no exceedences of any known aquatic life or human health criteria.

Appendix B2. Stressor Analysis Evidence Sheet for South Fork Pound River

Ammonia:

- Supportive:
- Non-supportive: None of the samples were above the MDL for ammonia.

Hydrologic Modifications:

- Supportive: Mining operations, including pre-SMCRA operations, have altered the hydrology in parts of the watershed; residential areas are primarily in the narrow flood plains at some locations in South Fork Pound River.
- Non-supportive:

Nutrients:

- Supportive: Dominance of nutrient-loving benthic organisms; low riparian vegetation could increase nutrient contributions from surface runoff; the medium ranking in DCR's NPS assessment for TP. P is limiting nutrient for eutrophication. Average dissolved N concentrations are greater than eutrophic sufficiency level at both PNS003.38 and PNS003.94. Average dissolved N at PNS003.38 has gone from a statewide median level in 1976-79 to approximately the 92^{nd}-percentile in 2006-07.
- Non-supportive: TP and dissolved P are reported by DEQ at or below their respective Minimum Detection Limits (0.01 and 0.05 mg/L, respectively) for all samples. No reported TP concentrations in excess of Virginia's "threatened waters" 0.2 mg/L threshold.

Organic Matter:

- Supportive: Moderate to high values of the MFBI at PNS000.40 and PNS004.98; dominance by the organic-loving Hydropsychidae and Chironomidae organisms; Tubificidae was also observed; low values for scrapers/filterer-collectors and high %filterer-collectors at both PNS000.40 and PNS004.98.
- Non-supportive: No problems with DO level. The 1999 sample at PNS004.98 and the 2001 samples at the intermediate station - PNS003.94 – had lower MFBI values (5.3 and 4.7 [average], respectively) with higher values for SC/FC and a lower values of %FC.

pH:

- Supportive: frequent DMLR groundwater pH values below the lower limit of surface water quality standard.
- Non-supportive: No DEQ ambient or biological field measurements exceeding the pH standards; no DMLR in-stream exceedences of surface water pH limits.

Sediment:

- Supportive: poor habitat scores for bank stability, embeddedness, riparian vegetation, and sediment deposition metrics (better at PNS003.94 than at the upstream and downstream sites); medium ranking for total sediment in DCR's NPS assessment; high historic TSS concentrations monitored by DEQ at PNS003.38. Occasional low %Haptobenthos metric values at PNS000.40 and PNS004.98.
- Non-supportive: Small TSS concentrations from DMLR sediment pond monitoring data; a healthy population of Haptobenthos for most of the sampling period.

TDS/Conductivity/Sulfates:

- Supportive: Average TDS, conductivity, and sulfate concentrations were greater then their respective screening values at almost every active MPID with DMLR in-stream, sediment pond, and groundwater monitored data; DEQ ambient monitoring also showed conductivity and sulfate values above screening values (TDS was not monitored).
- Non-supportive:

Temperature:

- Supportive: Low riparian vegetation habitat metric values at PNS000.40 and PNS004.98, which could reduce shading.
- Non-supportive: No exceedences of Class IV water quality standard of 31°C.

Toxics:

- Supportive: Several reported violations of the consensus PEC value for Nickel in 2001 and 2006, several low organism sample counts in the early 1990’s.
- Non-supportive: No reported fish kills; no exceedences of any known aquatic life or human health criteria.

Appendix B3. Stressor Analysis Evidence Sheet for Phillips Creek and Donald Branch

Ammonia:

- Supportive:
- Non-supportive: Although no samples were taken in Phillips Creek or Donald Branch, none of the samples taken farther downstream on the South Fork Pound River were above the 0.04 mg/L MDL for ammonia.

Hydrologic Modifications:

- Supportive: Mining operations have altered the hydrology of the entire watershed;
- Non-supportive:

Nutrients:

- Supportive: Dominance of nutrient-loving benthic organisms; the medium ranking in DCR's NPS assessment for TP.
- Non-supportive: High riparian vegetation score; very low TP levels at the downstream stations on South Fork Pound River.

Organic Matter:

- Supportive: dominance by the organic-loving Chironomidae and Simuliidae organisms; %FC greater than 95%; moderate to high values for the MFBI metric.
- Non-supportive: No dissolved oxygen problems.

pH:

- Supportive: frequent DMLR groundwater pH values below the lower limit of surface water quality standard.
- Non-supportive: No DEQ ambient or biological field measurements exceeding the pH standards; no DMLR in-stream exceedences of surface water pH limits.

Sediment:

- Supportive: very low Haptobenthos population in 1999 (increased in 2006); poor habitat scores for bank stability (increased in 2006), low embeddedness; medium ranking for total sediment in DCR's NPS assessment; lots of mining activity.
- Non-supportive: Small DMLR in-stream and groundwater TSS concentrations; Riparian vegetation and sediment deposition scores were high; lots of reclaimed AML areas.

TDS/Conductivity/Sulfates:

- Supportive: DMLR in-stream monitoring showed that average TDS, conductivity, and sulfate concentrations were all greater than their respective screening values, DMLR groundwater monitoring showed higher conductance and TDS.
- Non-supportive:

Temperature:

- Supportive:
- Non-supportive: No exceedences of Class IV water quality standard of 31°C.

Toxics:

- Supportive: low %Shredders.
- Non-supportive: No reported fish kills; no low numbers of organisms in any sample.